THREE CENTURIES

OF

PERPETUAL MOTION.

By HENRY DIRCKS, C.E.

COMPARATIVE SIZES OF THE TWO MOST CELEBRATED SELF-MOTIVE WHEELS.—[See Chapter II.]

FIG. 1

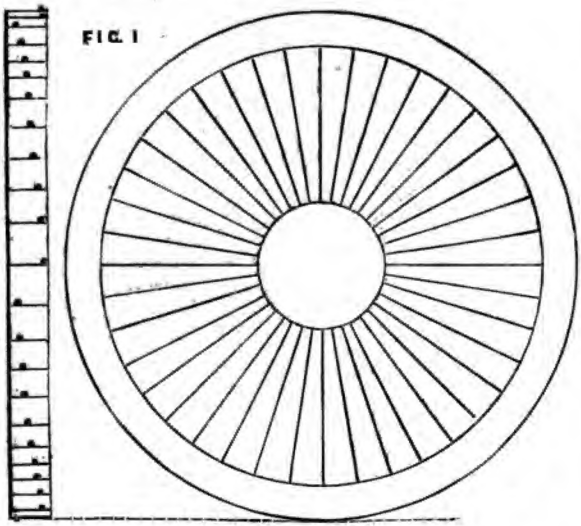

FIG. 2

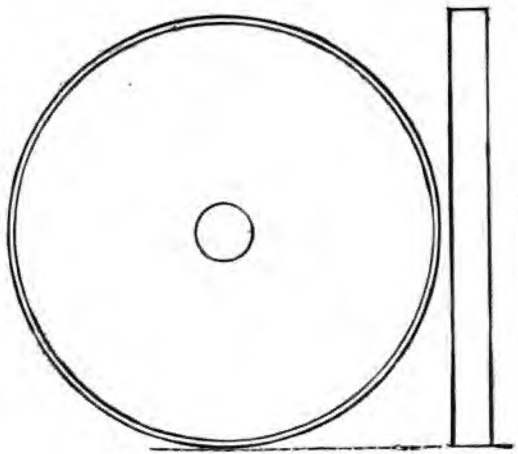

Fig. 1.—Invented by the Marquis of Worcester, prior to 1649. Its diameter 14 feet; and worked by forty 50 lb. weights.
Fig. 2.—Invented by Councillor Orffyreus, 1712. Its diameter 12 feet by 14 inches broad—very light, and covered with oil-cloth; exhibited 1717.—[See pp. 37 and 208.]

PERPETUUM MOBILE;

OR,

SEARCH FOR SELF-MOTIVE POWER,

DURING THE 17TH, 18TH, AND 19TH CENTURIES.

ILLUSTRATED FROM VARIOUS AUTHENTIC SOURCES,
IN PAPERS, ESSAYS, LETTERS, PARAGRAPHS, AND NUMEROUS
PATENT SPECIFICATIONS.

WITH

AN INTRODUCTORY ESSAY,

BY HENRY DIRCKS, C.E.

"A MOST INCREDIBLE THING IF NOT SEEN."

Marquis of Worcester.

"THE HUMAN UNDERSTANDING IS ACTIVE, AND CANNOT HALT OR REST; BUT EVEN, THOUGH WITHOUT EFFECT, STILL PRESSES FORWARD."

Bacon.

LONDON:
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1861.

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PERPETUUM MOBILE.

CONTENTS.

* Probably the machine patented by Asaert, of Lille. (See page 451.)

PREFACE.

WHO will not be reminded, on perusing the title of this book, of the exclamation—"Will no one write a book on what he understands!" Great will be the disappointment of him who seeks here to find an account of any veritable Perpetual Motion; or, to be enlightened on the art of constructing any such machine. Neither will he even meet with any very powerful arguments for or against its possibility. Either way, whatever may be his views, we opine he will discover many deficiencies, little to praise, and, as in all other human works, much to censure.

Can such a book be a desideratum? Yes; because it supplies a niche hitherto vacant in the history of Mechanical Science; it opens to view a curious phase in the mental constitution of a certain class of inventors; it brings into a comprehensive form their labours and the opinions of their opponents, gathered from sources scattered through a vast variety of works—many inaccessible to the general student; and, lastly, it exhibits an amount of infatuation respecting patent schemes that would otherwise have remained long unknown; or, if asserted without this evidence, could scarcely have been credited. If this publication tends to the attaining of no other result than arresting the further operations of this misguided, though ingenious, class of men, it will have erected a step in the ladder of advancement.

The writer at a very early period of life became aware of

INTRODUCTORY ESSAY.

1. In the classic ages, Invention was restricted almost exclusively to Poetry and Painting, hence to however remote a period we may trace the history of manual arts, we find it barren of all interest, save that which always attaches to a comparatively primitive character. Except as considered Metaphysically and Mathematically, we cannot but feel surprised how the idea of a self-motive mechanical power should have originated, or at what period it could have been called into existence. As emanating from the fruitful fancy of the poet or romancer, it may readily be conceived, but with what object and by what means the rude mechanician of a remote antiquity would attempt it, is not readily to be conjectured. All modern ideas on the subject would reasonably ally it with improvements early connected with Horologe, when automata of every kind engaged the attention of the ingenious mechanician; or, to a period when water and other natural agents were commonly to be seen operating machines employed in mechanical arts, and which, as they were early brought to a state of considerable perfection, the *ne plus ultra* would most likely, for a long time, appear to have been attained; and what then would be more natural, in the onward progress of improvement, than to seek for the obtaining of power by some direct application of gravity? The problem of a Perpetual Motion once promulgated would prove highly attractive, as it would appear in a primitive age easy, natural, and perfectly attainable. Imagination may thus supply the probable process originating this pursuit, one equally curious, contra-

dictory, and seductive. We cannot trace the history of its practical operations previous to the sixteenth century, and at that era only to a very limited extent.* When, however, we consider the mutations and difficulties attending early histories generally, we have little to be surprised at in the fact of this meagre information. Whatever may have been the fate of this class of lost inventions, certainly—so far as may be judged from modern models—we seem to have no great occasion for regret; except, indeed, such as would unquestionably apply to the curiosity of their mediæval character.

2. In the seventeenth century we find schemes for applying magnetism, pneumatic agency, weights, and atmospheric changes. To this period belongs the celebrated invention of the Marquis of Worcester, exhibited by him before Charles I. and his court. During the same century were established, in London, the Royal Society; and in Paris, the Royal Academy of Sciences.† These learned bodies showed less fastidiousness than they afterwards observed, in the class of Memoirs they admitted, consequently we find both were drawn into discussion, by their members, on the then popular topic of the time—"Perpetual Motion." Patents were also being granted in England thus early for reputed perpetual motion machines.

3. In the eighteenth century it was currently reported that the discovery was at length made; sometimes propagated by the public press, at others by the scientific journals then coming into repute. The latter admitted papers in which

* In the 16th century, Edmund Jentill, in a letter to Lord Burghley, dated October, 1594, amongst other matters, professed to have discovered "A perpetuall motion of sufficient force to dryve a myll;" afterwards, in another statement, adding the words, "in any standinge water, or quike springe, which maie alsoe be converted to sundrie other uses comodious for all estates, which have hetherto byn supposed to be unpractyzable." See "Science in England," illustrated in letters from the reign of Queen Elizabeth to Charles the Second, edited by J. O. Halliwell, F.R.S., &c., 8vo, 1841, pp. 35-6.

† See their decision against admitting and discussing papers on the subject, pp. 190-1.

the subject was treated rather favourably than otherwise; and the "Annual Register" and "Gentleman's Magazine" made known the invention of Orffyreus, which had acquired remarkable notoriety in Germany; attributable perhaps to the large premium he required, and the patronage of a Prince of Hesse Cassel. To crown all, during the South Sea Bubble mania, the prospectus was issued of a company "For a Wheel for Perpetual Motion."*

4. But it is to the present century we must look for abundant and various schemes. The ready means afforded for making such plans public, through the medium of cheap popular scientific journals and magazines, and likewise the facilities afforded for patenting inventions, have brought to light much curious matter.

5. Before proceeding further, it becomes requisite to premise in what sense the term PERPETUUM MOBILE, or Perpetual Motion, should be taken; that is, in its mechanical application, which is the only one we have to consider. The term must unquestionably be used in a modified, and not in its absolute literal sense; being thus accepted as one early, yet wrongfully, though popularly applied, it distinguishes inventions intended to be operated through the medium of their own peculiarly-constructed internal arrangements, and seems afterwards, though improperly, to have been extended to ingenious automata, worked by external agents, as magnetism, &c.; which latter we reject entirely. It is manifest that the term neither does, nor ever can, strictly apply to any product of human intelligence. In this limited sense it means any machine which (independent of wear) would not run out. A ball always rolling, a fluid always flowing, a wheel always turning—each operating by gravity alone—would exactly fulfil the required condition. But not so machinery moved by any external communicated power, as the tides, wind, electricity, temperature, or like agencies. We may even go

* See Anderson's History of Commerce.

the length to assert that, in this strict mechanical sense, even the planetary system offers no exhibition of perpetual motion in the several planets themselves, although each is in perpetual movement. The distinction lies here :—the motions of the earth, for example, are referable to other causes than its own structural arrangement, internal or external. By Perpetual Motion, then, is simply to be understood—a self-sustained continuous mechanical motive power; and which we shall now next proceed to consider.

6. A German metaphysician declared his preference to truth being hid, even had he the choice of its being otherwise, from the exquisite gratification which the search after it affords the true philosopher. The long-hidden truth respecting Perpetual Motion has exercised the mental energies of men of the highest intellect, and has entangled in its toils men of the humblest attainments. Much as is known respecting what has been done in this investigation, how much remains untold! In action, if not in words, those who seek for this *perpetuum mobile*, much as they desire to find it, take no small pleasure in the endless contrivances it requires and suggests. The inquiry always presents itself to the mind as exceedingly simple and easy; particularly to the uninitiated. The early life-history of inventors continually informs us of the youthful genius fascinated with the pleasing prospect of cutting the Gordian knot. The early career of Sir Richard Arkwright was marked by his acquaintance with the clockmaker Kay, who made the first model of his memorable cotton-spinning machine, through his applying to him to construct a perpetual motion model. And it is really remarkable to find that inventors are not wanting who, although not possessed of any assured proof of its possibility, nay, in direct opposition to every announcement of its impracticability, and as if in contempt of every censure heaped on the pursuit, are still to be found rushing into this hazardous arena. It has been condemned as a chimera, an *ignis fatuus*, an absurdity; and yet adventurers are nothing

daunted. Surely this opens to us a curious phase of the human mind, that sets at nought the dicta of mechanics and mathematics, and the admitted laws of nature.

7. Any machine would deserve the distinctive character of being a perpetual motion, that acquired its rotation, supposing it to be a wheel, from a property consequent on the arrangement of its internal parts, always compelling one side to become heavier than the other; such motion being no other than the ability in a machine to generate and maintain its own power of movement.

8. The attempts to solve this problem would seem, so far, only to have proved it to be thoroughly paradoxical. The inventions resulting from it during the last three centuries baffle any attempt at classification developing progressive improvement. It would almost seem as if each inventor had acted independent of his predecessors; and, therefore, frequently re-inventing, as new, some exploded fallacy. These retrograde operations, and strange resuscitations, have led to unmitigated censure, and a sweeping charge of ignorance, imbecility, and folly. No doubt many instances exist especially deserving the severest treatment; but unsparing censure loses half its causticity, and it shows a weak cause, or weaker advocacy, to condemn all parties alike as deficient both in learning and common sense. It has long been, and so remains to this day, an unsettled question, whether Perpetual Motion is, or is not, possible. To name no other, it is evident, from their writings, that Bishop Wilkins, Gravesande, Bernoulli, Leupold, Nicholson, and many eminent mathematicians, have favoured the belief in the possibility of Perpetual Motion, although admitting difficulties in the way of its discovery.* Against it, we find de la Hire, Parent, Papin, Desaguliers, and the great majority of scientific men of all classes

* A recent German writer says:—"The discovery of such a motion is difficult, *but not impossible*, as Kästner, Langsdorf, and other celebrated mathematicians, have frequently shown. (See page 405.)

and countries. It is evident, therefore, that even mathematicians are not agreed. But to the further consideration of this point we shall presently return.

9. The inventive faculty in most men in early life, and in others during their lives, according to the power and bent of their genius, information, and position in life, takes an essentially romantic turn, unless curbed by experience or necessity. This is no evil omen in youth, but is scarcely excusable at a riper age. Invention should not be always soaring among clouds, and finding delight only in mysticism. A fervid imagination forbids the seeing of impossibilities, even when opposed by stern realities. The theoretical or the practical engineer, unhappily led away by this substitution of prolific fancies in place of sound judgment, is the last person to be convinced by the most obvious obstacles to success, in the fulfilment of his views and statements. To him, every opponent is the victim of little-mindedness, prejudice, and envy. To himself, all his opinions stand for realizable objects. We cannot avoid having some, though a very chastened, sympathy with such enthusiastic projectors, who would seem to pride themselves on the strongly-expressed notion that "genius to madness is near allied." It is, unquestionably, in such cases, a constitutional weakness, ill fitting its possessor for that calm, cool, reflective character which alone commands confidence and ensures respect. The class of men who form the largest body of inventors are better practical than theoretical mechanicians; to them the refinements of geometers are truly a fountain sealed, and it would perhaps be difficult to offer propositions and definitions level to their general comprehension; but the attempt is worthy of the most gifted mind. If they do not always see the bearing and consequence of one being equal to one, a pound to a pound, the like to the like, and other profound expressions, of this at least they may rest pretty well satisfied—that the easier the problem of self-motive power appears to them, just in a reverse ratio is it the more difficult;—and that just

in proportion as they see two or any greater number of equally feasible constructions, they may with certainty take them as representing, not Perpetual Motion, but the squares of distance they are by consequence from the goal of their ambition.

10. The history of the search for Perpetual Motion does not afford a single instance of ascertained success; all that wears any appearance of probability remains secret, and, like other secrets, cannot be defended in any satisfactory way against the opinions of the sceptical, who have in their favour, in this instance, an appeal to learned authorities against the principle of all such machines, and the total want of operativeness in all known practical results. Published statements afford sorry examples of talents and ingenuity strangely misapplied. Some, but very few, are slightly redeemed from contempt by a glimpse of novelty. Of genius all are deficient, and the reproductions of known fallacies shows a remarkable ignorance of first principles on one side, and of the most ordinary sources of information on the other. One of the grossest fallacies of the mind is that of taking for granted that ideas of mechanical constructions, apparently the result of accident, must of necessity be quite original. The history of all invention fairly leads to the conclusion that, were all that is known to be swept from the face of the earth, the whole would be reinvented in coming ages. The most doubtful "originality" is that which any inventor attributes to his ignorance of all previous plans, coupled with an isolated position in life. It may be granted that the desire of *secrecy* often renders investigation difficult, and, from some remarkable feeling of this nature, most inventors of supposed perpetual motion machines, believing themselves possessors of this notable power, make it a matter of profound secrecy.

11. It is difficult to surmise whether the expectancy of honour or hope of high reward has most contributed to promote investigations of this character, and led to the folly of

making a great secret of the presumed discovery. Each in its turn has indubitably had its influence. They who sought fame have been most miserably disappointed; and as to wealth, who has ever seen a return for his first outlay? At one period, the large premiums of from £10 to £20,000, offered by Government for means to discover the longitude at sea, stimulated many; and when rescinded, the problem lost nothing of its interest with many really ingenious individuals; for at that period there was a real difficulty for the inventive to know what to invent, to satisfy their desire of producing novel mechanical contrivances. The evils of secrecy are numerous. The inventor is left to believe in a bubble; the public are deluded, and impostors reap the only harvest, by imposing on the credulity of all lovers of the wonderful—of which *a secret* will generally be accepted as one; while the deceived are mostly prompted by the hope of making a discovery. And who can deny the pleasure there is in solving a secret?

12. An object of such long-continued, inveterate, and industrious inquiry might at least be supposed to be attainable, and when attained to be of superlative value. Reserving the first inquiry for further observation, we will only presume its possibility admitted, and direct attention to the only probably correct estimate of its intrinsic value. It has been attempted to effect Perpetual Motion by water, mercury, sand, levers, inclined planes, Archimedean screws, Barker's mills, water-wheels, single wheels, drum wheels, multiplied wheels, and other mechanical means. One might almost desire to know what has not been put on its trial to make wheel-work continually turn itself. A thousand failures do not prove the thing impossible, because a thousand persons may have taken a wrong direction. But it proves this, that something, however trifling, is wanting; so small, it may be, perhaps, that no one has hitherto taken the trouble to look for it! Suppose it to be something to act as a lubricator; or something as a detent, at a particular point. Does not this at once suggest

the weakness and feebleness of such a machine for any utilitarian purpose? It must be plain that it would, at best, be little more than an exquisitely curious toy.

13. Many persons may have been drawn into this amusing pursuit under the influence of vague impressions that self-motive power was but a lost invention. The more abstruse the inquiry, the more some minds are gratified in probing the subtleties which mystery abundantly affords. Hence Judicial Astrology, the Philosopher's Stone, the Quadrature of the Circle, the Multiplication of the Cube, the Elixir Vitæ —a panacea for all diseases—have each been sources of intense study. The metaphysical Cowley says, in "The Adept," that, though he—

—— his great secret miss,
For neither it in art or nature is,
Yet things worth while his toils he gains;
And does his charge and labour pay
With good unsought experiments by the way.

The Baconian Philosophy has so far discouraged as to have dispelled nearly all these chimeras. Only for its influence, dreams of philosophy would have increased, rather than, as they have done, fallen into decay.

14. We will not, however, close here, but endeavour to show, from comparatively recent personal experience, the working effects of taking up the study of Perpetual Motion as a serious employment—some men experimenting for years, others for the best part of a lifetime. All studies of a mental kind may be, and continually are being, carried to excess. It has been so in Painting, in Statuary, in Music, in Literature, and in all the Learned Professions. The "pursuit of Knowledge under difficulties" has driven many to despair; and the irritability, anxieties, and distresses of "Genius" under every phase, have been admirably depicted by D'Israeli. The "Martyrs of Science" have been many—the victims to the pursuit of Perpetual Motion not a few. If Hartmann of Leipsic hanged himself from despair at his vainly-spent life

in prosecuting this hopeless attempt, could not an equally sad tale be related of many a Poet and Artist? But to proceed, we will first give a series of short narratives relating to modern instances of devotion to this search after a self-motive power*; followed by extracts from several years' correspondence.—First, of personal narratives:—

I. A tall old Welshman, a custom-house officer, imagined he had found out Perpetual Motion by some peculiar application of sand from the sea shore. He went to London with the machine he had invented, and applied to the Board of Longitude, but without receiving any encouragement. He used to say that it was while listening to a sermon at St. James's Church, Liverpool, from a particular text (which he never named) that he had the first idea of the machine he had invented.

II. A watchmaker showed his customers the model of a wheel and weights in his shop, belonging to a German. It had employed a man three months cleaning, and had been left on his hands for ten years, therefore he supposed the German would never redeem it, although he had travelled with the machine all over Europe. He had some means of making it work; but walking across the room, or a passing cart in the street, would suffice to jostle and stop the works. The same watchmaker had been presented by some other party with a pamphlet entitled "Perpetual Motion: explained as it is discovered in nature. By Peter Brentano. Gloucester: Printed by William Verrinder, 24, Southgate Street, 1830." 27 pages. It is arranged under these heads:—

Page 3. "Perpetual Motion, or, self-possessing power to move in space void of air caused by a method of forcing the

* Since these narratives were arranged, the author has been informed, on unquestionable authority, that Ramsden, celebrated for his dividing machine, used frequently to mention the fact of the late Duke of Gordon, at Aberdeen, being deeply and expensively engaged in carrying out experiments for obtaining Perpetual Motion.

water which runs out of a tube, back into the same tube again, the power for forcing back the water gained by levers."

This is followed by two engravings, one representing an "Iron Case."

Page 11. "Formation of a Vacuum for the Moving Machine."

Page 12. "Illustrations."

Page 14. "Creation of Time." [Genesis, chap. 1, verses 1, 2, 3, 4, 5.]

Page 20. "The Formation of Time." [Genesis, verses 6, 7, 9, 10, 13, 16, 17, 18.]

Page 24. Job, chap. 38, verses 5, 8, 9, 10, 11, 14.

III. Mr. S—— had a curious Perpetual Motion contrivance, constructed of double cones, made with mathematical precision. His first trial of it was before his wife, and shut up in his room, where all it wanted was his continued presence and assistance!

IV. Mr. E——, a very ingenious workman, devoted all his time to mechanical pursuits in relation to Perpetual Motion, reducing himself to a state of beggary through his fondness for his favourite pursuit. He was always in high spirits, speaking confidently of his success being near and certain; yet, to the last, one thing was wanting, the very thing first sought.

V. Mr. P—— followed the pursuit of Perpetual Motion above twelve years, until at last his mind became affected. Later in life he preferred being silent on the subject. He used to say his notions of it were very simple, so much so, that were he only a practical mechanic he should not doubt of success, but that to place his plans in the hands of workmen would only expose his inventions to his disadvantage. He contrived a quantity of apparatus principally on a large scale, with different kinds of wheels, some operated by water, and all intended to be kept constantly overbalancing.

VI. Mr. E—— states that Mr. Charles, of Bala (Wales), in

his Dictionary of the Bible, under the article "Mills," relates of mills in Wales which worked without wind or water, or the aid of man, after being once set in motion. This, Mr. E—— says truly, is very like Perpetual Motion. Mr. Charles, he proceeds, further states that, about the year 1500, William Salisbury (first translator of the Bible into Welsh) had a mill of this description. He also gives an account of a wheel and millstone found near Corwen, supposed to have belonged to such a mill. The wheel was all of wood, *except one quarter;* the axle was the thickness of a man's thigh, and the millstone three feet diameter, having a piece of metal attached to its edge, which had probably been a loadstone! Mr. E—— says he has tried many plans for Perpetual Motion, all of which have failed; he has thought of a hundred schemes or more, but still he thinks he knows of one plan superior to all hitherto tried.

VII. In Manchester, a man forty years of age, who had made his money as a common moulder in a foundry, expended the sum of three hundred pounds in models of wheels having falling arms, arranged with the intention of always preponderating on one side, made for him by a watchmaker.

VIII. Mr. B—— of London, philosophical instrument maker, entered into an engagement with a gentleman, who bound him on oath to keep the secret of his plans in working out his scheme for Perpetual Motion, under a penalty of one thousand pounds. His employer, a rich gentleman, expended above two thousand, and himself one thousand pounds in fruitless efforts. Mr. B—— when speaking of their career, would take up a scrap of paper, and tearing off a very small portion, exclaim—"We got it—all but that," throwing the paper scrap on the table.

IX. Mr. R—— was made a confidant by a friend of his, who so firmly believed himself possessed of a veritable self-moving and most powerful machine, that he consulted Mr. R —— on a means of stopping it, after its being once set in motion!

X. A mechanic, a model maker, had a neat brass model of a timepiece, in which were two steel balls A and B;—B to fall into a semicircular gallery C, and be carried to the end D of a straight trough D E; while A in its turn rolls to E, and so on continuously; only the gallery C not being screwed in its place, we are desired to take the will for the deed, until twenty shillings be raised to complete this part of the work!

XI. Mr. F—— professes to have an unfailing Perpetual Motion, obtained by making the vertical pressure of a column of water work a four-feet wheel, which by a fall of eight feet will enable him, with a one-foot crank, to raise water to a pump to supply the cistern above, and, after allowing for friction, leave a surplus of above one-third of the power employed. He has, he says, studied Perpetual Motion for twenty years; and has several plans, but this he estimates to be worth all the rest. His brother, who has followed the same pursuit, has a room set round with machines, none of which ever went. His nearest approach to success was in a method acting by the percussion of balls, one after another, as a wheel revolved; on which, and other plans, he has expended upwards of £1500. Mr. F—— knows a gentleman who has been thirty years engaged on this subject, and is pecuniarily assisted by a person of good means.

XII. In a conversation with Mr. ——, he stated that a friend of his, although he was a Professor of Mathematics in one of our Colleges, had invented a mode of propelling vessels, which was only what would be called a Perpetual Motion; yet he was for years infatuated with his plan, before he could satisfy himself that it was preposterous to expect it to operate as a propulsive power.

XIII. Mr. ——, a dissenting minister, then resident in the North of England, in conversations with his nephew, about the year 1835, mentioned his having been 14 years seeking to discover Perpetual Motion, in which he at last succeeded, having had a wheel with rolling balls in motion several days; after which he destroyed it to avoid discovery, retaining only

his drawings. He had castings made, which he could finish in a lathe himself, with all other requisite work for his invention. He was a good linguist and mathematician, and died at forty years of age; his relative considered that he must have expended at least £1500 in experiments. His brother, also a minister, could not be persuaded, by drawings, of the possibility of this continuous movement, but still he sent an account of his brother's invention to a local publication, about 1835-6.

And secondly, the following extracts from correspondence are offered in further corroboration of the opinions and feelings of inventors once entangled in the meshes of this mechanical dilemma:—

XIV. Mr. P—— writes from Slough, 6th Nov., 1847:—"I have discovered a system by which *Power* to any extent may be procured by a self-acting piece of machinery. My object is not the amount of money, but to meet with a party who possesses sufficient knowledge and influence to procure and protect a patent."

XV. Mr. H——, Islington, 28th July, 1848, says:—"Having matured the plan of a mechanical improvement which I am persuaded will be highly profitable to any capitalist who will join with me in taking out a patent and applying the invention to practical use, I beg leave to certify the same to you. When I state that I have submitted a drawing and description to the scrutiny of Lord G—— and Mr. V——, and that they have both borne practical testimony of their favourable opinion by presenting me with a handsome contribution, I trust you will not allow any preconceived opinion of the impossibility of Perpetual Motion to operate to my prejudice, when I announce that such is the object of my invention."

XVI. Mr. H——, of Weymouth, 12th Feb., 1849, communicates about "a continuous revolution machine, which overcomes gravity," and "has friction wheels to stop it!"

XVII. Mr. H——, Hinckley, 21st Jan., 1850, writes:— "Sir,—As I am confident of the machine going, but am in want of money, which stops its progress, I am sure from £4 to £6 will set it a-going." He had previously written:— "Sir,—We have always understood that there was a free patent and a premium for any one that discovered the Perpetual Motion."

XVIII. Mr. R——, Liverpool, 26th Nov., 1850, states:— "I have invented a machine to give motion to any kind of machinery. Its power is not derived from any changeable or expensive element; in short, it is a Perpetual Motion. It may be applied to any stationary machinery, but not to ships and carriages. I have not made a practical experiment of it, but its truth is clear and simple.* What I expect to have for it will be £500 sterling."

XIX. Mr. K——, Pentonville, 20th Dec., 1850, corresponds about two inventions:—"No. 1. Maintaining power by machinery, to gain any power that may be required, to any extent; and No. 2. A maintaining water power from a well, or still tank, thereby to get a perpetual water power."

XX. Mr. M——, Liskeard, 10th May, 1852, writes about his "new motive power," of which he states:—"The advantages are its *cheapness* and *simplicity*, not costing more than about £1. per horse power, and its perpetuity of motion, for it will start itself, and will go for ever without requiring any attendance, except for oiling, repairs, &c. As it is not patented, of course I would not describe it further than to say, it is worked by an entirely new principle which I have discovered." In another letter he says:—"The motive force is the buoyant power of water, a force which costs nothing, and is easily obtained."

XXI. Mr. H——, Kent, 23rd Aug., 1852, writes in a strain which excites our interest and sympathy:—"I have com-

* It turned out to be an endless band or chain carrying buckets to fill an upper cistern, from which it was to be worked.

pleted (he says) a most valuable invention to give true time at sea; it supersedes the use of the chronometer, has no spring, and never requires to be wound up, being self-acting. It acts by the gravity of mercury, and as *gravity* is not affected by temperature, when set to Greenwich mean time continues to show that time in every climate or part of the world. It is an invention of the most simple kind, truly mathematical in its mechanical construction, both in practice and theory. It solves the problem of *Negative Attraction*, which is this:—A raises B, acting on a wheel C; and B raises A to its former position, continuing the motion of the toothed wheel C, *negativing* the attraction of the gravity of A, merely by the *change* in the *position* of B, which is mercury, whose gravity shifts in the tube that contains it; and this change of position, from left to right, and *vice versa*, constitutes a self-acting balance compensating lever, and that acts on an equally simple and compensating escapement, which is effected by the force of A and B, ultimately; with these, and four wheels, the machine is a complete chronometer, giving quarter second time. It can be varied in size and weight, and can be equally applied for a church clock or a watch. This invention has cost me thirty years' study and experience, and now that I have obtained the result required mathematically, I am aware of its value in a double sense; the English patent alone is worth £60,000 *to the trade* of Horlogery generally, and at the same time from neglecting every other thing to attain this object, I am in want of means to render me so far independent of the trade as to be able to *demand* the above sum, or carry out my principle by absorbing the sale of self-acting chronometer watches and clocks."

XXII. Mr. S—— writes from Creetown, Scotland, 12th June, 1855:—"I have a small machine I think might come to be of some use to the public; it is a small engine, the same nearly as a steam-engine, which could work itself, without either steam or anything to assist it. It would require no assistance after it commenced, except oiling. I

think I might have something for it, as it would save every cost after put up. It would require no winding up or anything. I heard that Government had a reward out for to try and find out something that could work itself. I think it would be of great use; it could drive mills or the like itself."

XXIII. An Irish correspondent (Mr. G——) writes from the county of Donegal, dated Moville, 25th Sept., 1855:—"After long and painful study of mechanical power, I have at present arrived at my purpose of a power that will drive the British Fleet, at no expense, and at speed never before thought of. I have been directed by some scientific gentlemen to bring the matter before you."

On the 5th Oct. he again wrote:—"I received your most instructive letter, and I trust it (the invention) will not turn out like the mouse and the mountain. To give you some idea of this great power, it is of very simple construction. There is but one wheel in the work, and the power can be raised to any imaginable height; this power turns the wheel, and the wheel turns the crank, and it will be found that no such simple, useful, and practicable invention has ever come under your notice. It is equally applicable to propel by either sea or land; either the largest ship or the simplest mill or loom can be driven by it, with the same ease; and the power can be raised in proportion to the necessity for it. It is taken from the clock, the mill, and the loom combined together. I have not the least doubt of the success of my invention. I have given it many trials, and produced very satisfactory results, but unfortunately I am not in a position, for want of capital, to carry out this great invention; it may fall back another century, if something does not arise to my aid. I have spent a great deal of money on this matter."

XXIV. Mr. P——, a gentleman of a very igenious turn of mind, writing from Cheshire, 29th Jan., 1856, says:—"I have not been brought up a mechanist in any shape, but invention and ingenuity are *natural* to all our family. Like many other fools, I spent about nine months in trying to dis-

cover perpetual motion. Now, Sir Walter Scott tells us such a thing can never be done, but were he here I could convince him to the contrary, for I discovered it in my first attempt, which was by attraction onwards on a level plane, and then by ever-counterbalancing gravitation backwards down an inclined plane. I secondly tried it on by leverage; I worked at it about six months, levers, wheels, cranks, and everything else innumerable, and the further I went the nearer I got to perpetual stand-still. In my third attempt I considered that in Hydrostatics the same thing that finds its centre of gravitation upwards, in Pneumatics finds its centre of gravity downwards; for instance, drop a piece of wood, it falls; place that same piece under water, it rises; so here, by a very simple contrivance, I got up and down perpetual motion to full perfection, but they all amount to nothing; I cast them aside as mere playthings, for all the power they can ever give is taken up in moving themselves."

XXV. Mr. A——, writing from Ireland, dated Ballywatter, 20th Feb., 1856, speaks of a "motive power" he has discovered, of which he states:—"It will prove safe, speedy and economical, though of astonishing power; it will be uniform and steady in operation, and at the highest velocity perfectly within the control of one man, I may say boy. When properly adjusted, it may also for hours, indeed for days, be left to its own discretion; especially if by mechanism oil be kept to its very few bearings. The power is a combination of weight, as the first mover, with the power of the lever, to which is added velocity as the result of both, and which varies with the amount of both."

XXVI. Mr. B——, of Bermondsey, 28th July, 1857, says: —"Sir,—I have (through curious circumstances) discovered 'perpetual motion.' It will be a wonderful engine, as it can be constructed to keep in motion (without the least assistance of anybody) everlastingly. I have not the means of carrying it on by myself, therefore I want somebody with money to assist me in doing so."

XXVII. Another Mr. B——, Wheyhill, Andover, Hants, 15th Oct., 1857, writes:—"Sir,—I beg permission to inform you that I am in a position to *prove positively* that motive power to any amount for propelling all kinds of machinery may be maintained without any cost whatever, save the wearing of the machinery by friction. This invaluable invention supersedes the steam-engine, but I cannot proceed to a public development without capital."

XXVIII. The last communication that will be here noticed was made by enclosing a printed circular, giving notice that —"Speedily will be published, dedicated to the British people, a Treatise on the discovery and application of a Continuous, Increasing, and Self-generating Motive Power, whereby the agency of steam is superseded in mechanical enterprises. By John Henry Vries, Esq., M.D." In this work the prospectus states:—"The Inventor enters into details relative to the Pneumatic Engine, of whose utility, as applied to practical purposes, Dr. V. is the discoverer.* General remarks follow (it adds), wherein the labours of Watt, Erichsen, Sir Humphrey Davy, and others, are dwelt upon, &c., &c." Only a limited number of copies are promised, at the price of 50s. each.

15. It is needless to extend personal narrative or correspondence as indicative of the general diffusion of a desire to discover the solution of the problem of a *perpetuum mobile;* in each instance adduced, however, will be found characteristic traits of the progress, hopes, disappointments, and untiring zeal that distinguishes the various inventors of this order. Those who read for the first time these statements of devotedness to what seems little better than laborious idleness; and peruse the collected examples of published plans

* Dr. J. H. Vries, in January, 1853, had granted him provisional protection for six months, for "Improvements in obtaining Motive Power," but not having been proceeded with, has become void. He employed electricity, the gases from water, a generator, and a rotatory engine.

for Perpetual Motion; and find that men have been so enamoured with these schemes that for three centuries they have not only continued patenting abortive efforts to maintain self-motive power, but rather increase than diminish in avidity to perpetuate their errors, will admit that it becomes matter for serious inquiry, Have Mathematicians and Mechanicians exhausted their powers of demonstration? Who is amenable for the evil which somewhere or other undoubtedly does exist to a lamentable extent; so much so, indeed, as to be a reflection on the intelligence of the present age of boasted enlightenment? We shall proceed to examine in order, the several facts connected with this remarkable subject, according to the various aspects in which it is generally viewed.

16. Perpetual Motion either is, or is not, attainable. We do not pretend to decide the question, but merely to show that much may be said on both sides. They who engage in experiments to discover Perpetual Motion, as well as they who undertake to disprove its possibility, equally find themselves beset with difficulties. It proves a paradox to both.

17. It is accepted by most scientific men that Perpetual Motion is impossible, because no body can at the same time be heavier and lighter than itself. But may there not, after all, be exceptions to this law, as in some other laws, stated in equally general terms? Thus, although water is said always to find its level, and heavy bodies to fall lowest,—yet, no one disbelieves in capillary attraction, or that the heavy fluid, carbonic acid gas, rises to a mountain's height.

18. The eminent French mathematician and astronomer Philip de la Hire, born in 1640, died in 1718. At the age of about 38 years he offered a demonstration on the impossibility of Perpetual Motion,* which it would seem has never been improved on for 182 years; and although the fact of its existence has been repeated by numerous writers, it never

* See page 102, and Appendix D.

appears to have occurred to any to reproduce it; his name, but not his reasoning, has been reiterated during the above period as sufficient to warn all projectors from any further pursuit of their favourite schemes. To say the least, such indifference is indefensible. Authorities are not wanting who employ his reasoning, but silence on this fact left the mechanic to suppose that something even still more conclusive against him lay hid in the closets of the learned. The wonder with many was, what M. de la Hire could have said so decisive and infallible. We now have his reasons before us; and we learn that they leave Gravesande, Bernoulli, and many eminent Continental mathematicians in doubt whether Perpetual Motion is impossible, and consequently whether M. de la Hire may not have offered too sweeping a denunciation against its possibility. The demonstration, intended to apply generally, does actually but take into consideration, as data, schemes previously known to be fallacious; therefore, such demonstration, however clearly unfavourable to one class of schemes, may not strictly apply to an entirely different order of inventions. As late as Nicholson (1800), we find this opinion supported. We may remark, for instance, that every demonstration takes for granted the free, unrestrained action of gravity. But suppose a certain arrangement could be introduced to frustrate this free action of a rolling or falling body, at some desired point, its liberation to be followed by a like suspension, and so on; such a modification would be beyond the range of the existing mathematical reasoning, which had never contemplated the element now supposed practicable. These examples may be paralleled by supposing theorems and problems relating to the action of a coiled spring, which would satisfy every one in regard to certain facts, but demonstrate nothing as to results attending the added regulating effect of a pendulum, assuming *that* to represent an unknown element, the something wanted, and alike sought in either case. Surely the greater the danger and folly of following Perpetual Motion, from believing it

attainable, the greater is the necessity for reducing the question to its true conditions, and satisfactorily settling the inquiry. An inventor desires to ascertain, not one, but all the difficulties that he may expect will frustrate his attaining his object. Knowing the real difficulty is next to being halfway to the attainment of his search. Here it is, however, that Mathematics ceases to assist him. It predicts nothing; it makes no discovery in mechanical invention.

19. Taking their tone from the strongly-expressed objections raised, and clearly and ably defined and demonstrated by Mathematicians, by Natural Philosophers, and Scientific Bodies, the public voice has, for more than a hundred years, been directed against Perpetual Motion as a dream, a delusion, a chimera, an *ignis fatuus*. It is likened to Alchemy and to the Squaring of the Circle. Censure is of the easiest possible acquirement. Few are aware how difficult it is to steer a medium course, and that, while there is no wisdom shown in abuse, it actually requires some skill, some information, and not a little practice, to praise or censure discriminately. It is not by displaying a nervous irritability that shrinks from all explanation, other than reiterated stale platitudes, that minds above mediocrity are to be satisfied on scientific matters. Why should a Perpetual Motion invention be pursued, more than other, timidly and secretly? More, perhaps, for one reason than any other; because persons who proffer friendly advice go so far out of their way, to cover their own ignorance of the matter, by offering false, and consequently offensive rather than convincing arguments.

20. Incessant failure does not, of itself, offer sufficient argument against the possibility of Perpetual Motion. The history of all science affords abundant evidence of this fact. Such opponents affect to despise Alchemy, the precursor of Chemistry; false enough in itself, and yet where would Chemistry have been at this day had Alchemy been unknown? Necessity often, but more frequently accident, led to the dis-

covery of many early inventions. In modern times, most discoveries are made solely by a train of scientific reasoning.

21. Another frequent but false argument is the offering of disparaging opinions drawn from absurd contrasts; as if failure in one invention or pursuit afforded cogent reasons against the possibility of some other diametrically opposite invention or pursuit. This favourite course of weak opponents, is too ridiculous an estimate of the proper method of settling such disputed points, to require farther comment.

22. Inutility is the presumed consequence of an impossible experiment, and no one can deny the fact. But on what ground is the experiment itself assumed to be impossible? It does not show very good common sense to argue without a sensible reason. What was the use of rubbing a small piece of amber?—or noticing the quivering of a dead frog's legs, or the action of copper and silver laid on the tongue? In a word, of what use is the electric telegraph?

23. But the most invidious distinction and the weakest argument adopted by well-meaning persons is, that the pursuit leads to "wasting time and fortune." We have no wish to uphold improvidence, but let us ask, what pursuit in life is ensured against this species of loss? That it is not peculiar to making geometrical drawings and innocently motionless wheels we feel well assured; nay, we doubt whether domestic life, with its many frivolous amusements and accomplishments, is always equally thrifty in expenditure, with these well-abused Inventors. If we admit our opinions to be swayed by such representations, how much have the inventors of Rotatory Engines, Screw Propellers, and a thousand other schemes, to answer for on the score of vast unproductive expenditure!

24. Lastly,—It is a singular want of liberality to impeach the understanding of any one who, for any reason whatever, attempts the discovery of Perpetual Motion. It is not too much to say, that there is scarcely any ingenious youthful engineer or machinist who has not more or less given his

mind to solving the problem. Infatuation is not confined to the pursuit of Perpetual Motion; and without attempting or intending the least apology for spending a lifetime or fortune, as a worthy employment of the one or the other, on a matter of such apparently second-rate value, yet, what is unjust in relation to arts and sciences generally, for the acts of a few of their weaker followers, is equally unjust in the present instance, which charges on thousands the foibles of a few eccentric individuals—a class of enthusiasts from which, unhappily, no pursuit and no walk in life is entirely free.

25. Opposition in the right direction might effect much good. A mathematician of an inventive turn of mind would, in endeavouring to prove the impossibility of Perpetual Motion, be in a fair way to discovery (if within mortal reach), as compared to the cleverest mechanic, seeing nothing before him but its ready achievement. The first would seek difficulties and ponder them; the other would see a machine in motion even before it was made; and we all know the danger of over confidence. Theoretically, Perpetual Motion may be actually neither impossible nor absurd; not so, however, the many pretended self-motive machines to which precipitation has given rise, all abundantly absurd. If the theory be sound, then in practice, have all results to which it has led been most unfortunate; whether considered in reference to inventors or to opponents.

26. We have, in this tantalizing pursuit, only found an ingenious lock, for which we want now to find a key. The key is all that is wanting. Many set out on the search for it, declaring its discovery to be of very easy attainment; experience has taught some humility, but posterity follows in their footsteps. Many an ardent student feels assured he has all but found it—such a mere trifle wanting. A few declare they know exactly where it is, and are providing instruments for its recovery. Several hasty aspirants have published their good fortune, to avoid piracy. Two found it, but alas! it has followed them to their graves; so

that, after all this boastful parade, the key is not yet forthcoming.

27. It is sufficient stimulus to the human mind, in entering upon any great undertaking, to believe in its possibility. What has been done by one may be done by another; so all reasonably argue. Now no doubt, what has tended more than anything else to keep alive the pursuit of Perpetual Motion, is an idea of its being merely a lost invention, and, therefore, undoubtedly possible. The scientific sage, however, views all these schemes alike as fallacies and absurdities; he can only see in them Nature opposed to herself, which is quite untenable.

28. Implicit credulity, no less than unlimited scepticism it, has been well observed, evidences mental imbecility. The multitude adopt the popular opinion; and the common belief of scientific men, and through them scientific treatises, being against the possibility of Perpetual Motion, it is self-evident which is the popular side. And there is little in the whole arcana of scientific knowledge to warrant any strikingly opposite view. Half a dozen scientific authorities ranged against some hundreds is not a very encouraging spectacle. And such is a true picture of the case.

29. Even Science is fallible; but Mechanics is not a science open to the discovery of new laws, as in Chemistry. If we seek for argument in favour of the possibility of Perpetual Motion, we must believe it attainable on known laws, by means which in no way infringe them, and which themselves only offer additional proof of their stability. Of this there can be no reasonable doubt. And Mathematicians, too, are correct, as far as they go, and where they stop.

30. The only appeal that can be made in apology for the pursuit of Perpetual Motion, is derivable from the results represented to have been obtained by the Marquis of Worcester in one instance, and by Orffyreus in another. All the circumstances relating to their singular inventions excite our curiosity, raise our scepticism, and induce us to pause in

our decision. Let us first consider the inventors personally; and secondly their inventions and the circumstances attending their exhibition. The two men were of very different character and position in life. The first noble by birth, of ancient lineage, loyal to the extent of sacrificing his property in support of the cause of Charles I., and evidencing by his prayers, his truly religious sentiments. About or before 1648 (as the King died 1649), he exhibited his wheel, or perpetual motion, in the Tower, before his Majesty, two Extraordinary Ambassadors, the Duke of Richmond, Duke Hamilton, most part of the Court, and Sir William Belford, Lord Lieutenant of the Tower. We have to consider the upright character of the Marquis, his having invented the steam-engine, his worthiness in all respects, and the circumstances here detailed, and then ask ourselves :—Little as Science favours any belief in such an invention, can we see any reasonable grounds for error in this great experiment, or believe that a person so distinguished, and so much to be admired in all other respects, could thus boldly and recklessly deceive himself, his noble company, and the public: taking ten years or upwards to elaborate and record a gross falsehood? It seems incredible, and true respect for the Marquis's memory will go far to maintain doubts respecting the infallibility of all mathematical demonstrations adverse to the possibility of a self-motive power. Secondly :—

31. Orffyreus was of humble origin, versatile talents, fickle, discontented, unsettled, irregular, and eccentric. He was ambitious, boasting, and the very man to raise up enemies. Between 1712 and 1718 he made and destroyed in succession four wheels or machines. He had learnt the art of clock-making, and several mechanical arts, and is supposed to have constructed or put these wheels together himself. He had a princely patron, who wished to obtain practical results from the invention for manufacturing and other operations. A misunderstanding ensues; and from that time to his death, in 1745—at least twenty-eight years—the subject lies

dormant, and the invention dies with him. This last fact, coupled with the wheel having raised so great a weight as 70 lbs., makes a doubtful case still more doubtful; and particularly when, about the same time, Geiser imposed on the German public with a mere piece of clockwork, as a true perpetual motion.

32. Next, as to the inventions of these two remarkable characters:—

The Marquis of Worcester's wheel was fourteen feet in diameter; it was rotated by the action of forty 50 lb. weights —2,000 lbs.—an enormous weight, requiring some very laborious operations of the carpenter, to erect a sufficiently strong framework. Its completion must have taken some time, and led to frequent visits from the noble inventor, as well as experiments to test its correct working, before offering a practical demonstration before majesty.

33. Orffyreus's fourth or last wheel, at Hesse Cassel, was twelve feet in diameter, fourteen inches broad, made of light oak framing, and covered with oil-cloth. It would revolve either way, and this alone casts a shade of doubt on there being any deception in practice with it. But, strange to say, it had power enough to raise 70 lbs. to a considerable height. Its operations were seen and attested by so many, that these broad facts rest not alone on the inventor's authority. It was so ingeniously made, that M. Gravesande wrote to Sir Isaac Newton on the subject; and his letter and mathematical reasonings, in reference to the matter, appear in his works, edited by Professor Lalande, 1774.

34. The subject of Perpetual Motion opposes paradox to paradox. It is viewed both as being most simple and most difficult to find. The learned justify both its possibility and impossibility. Many mechanics believe it possible; but of the only two accepted cases, both prove secrets. Its pursuit always commences in confidence, only to end in doubt. It is as near being discovered now as it was three hundred years ago; it was then tried, and is now beginning. Inventors

stand at cross-roads, arguing as to which is the right path; although there are only two roads, all are allured to take the wrong. Of two men supposed to have got into the right track, some think both were impostors, and many believe that, one at least deserved no better character. Most inventors reap honour, or at least commiseration; here they are assailed with opprobrium. Such is the fate of this paradox of paradoxes.

35. It is a singular coincidence, that the only two accredited inventions acting as evidences of Perpetual Motion, one about 1649, the other 1712, should both have been treasured by their inventors, and yet be lost to posterity. Nothing satisfactory can be advanced to justify secrecy under such circumstances. If due to accident, it may have been unavoidable; if otherwise, it evinces a narrow selfish principle, to the suspicion of which no man should lay himself open. Our belief in either is necessarily wavering. We view each with suspicion. Our confidence is shaken by known facts, and receives no confirmation from any results obtained by those who thus withhold from us that evidence, the truth of which we ourselves might easily have tested.

36. Disbelief in the possibility of Perpetual Motion pervades all scientific classes of society, from whom the popular tone is taken. Yet among scientific men it is often disbelief with a mental reservation. The most incredulous mathematician would like to examine a so-called perpetual motion, while he would scout the idea of listening to any attempted proof of the multiplication of two equal amounts to produce an unequal one. It is in the very nature of mathematical and mechanical science to afford evidence that runs entirely counter to the idea of self-motive machinery. At the same time, as scientific attainments enlarge the understanding, they could have no effect to prejudice the most learned against receiving ocular demonstration of any fact on this subject, however opposed to preconceived views.

37. There are only a limited number of methods which at

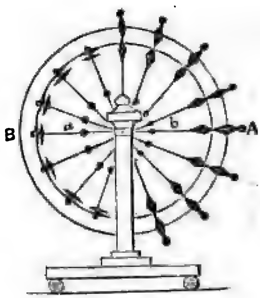
the utmost can be expected, by the most sanguine, to offer a transient hope of success; as wheels, with solid or fluid weights arranged somewhere around their peripheries. Such plans are capable of analysis; but, if complicated, are all the more likely to prove abortive in results. It is not to be expected that the discovery, if to be made at all, will ever be the result of haphazard experiment. Ignorance has already done its work, and no one should now have the presumption to attempt it, unprovided with a large fund of intelligence, and no small ability in experimental investigations generally; remembering—

> A little knowledge is a dangerous thing:
> Drink deep, or taste not the Pierian spring:

for, as sad experience truly shows—

> There shallow draughts intoxicate the brain.

38. Appearances are every way so much opposed to offering any plausible hope of success, that all the wisest can say amounts to no more than—It may be found; or, it may never be found; and, if found, the discoverer will probably establish the fame of others quite as much as, if not more than, his own. The insufficiency of the only supposed means of solving the problem—namely, by contriving a wheel so that all the weights on one side shall be constantly farther from the centre than the weights of the opposite side—has been attempted to be shown in a palpable manner by Desaguliers (see pages 79 and 89); but the author has invented a model apparatus of a more convincing character, being an actual wheel, as represented in the annexed diagram. We have here a wheel A B, having a number of spokes, each terminating, at or beyond the periphery, with a weight. It is represented with all the weights extended farthest on the right hand side,



Now, on giving it a reverse revolution, all these weights will recede, and the weights on the left hand side be extended in like manner. Yet will nothing be gained; in every position it will remain neutral. It consists of spokes, as A *a* and B *b*, each terminating at their ends A and B in compound levers, or lazy-tongs, while their opposite ends *a* and *b* pass through a hole drilled in the axle; and so for each spoke, which must have a weight equal to the weight of the opposite end. Spokes thus made, when vertical on the top side of the wheel, are extended, while the opposite bottom spoke is depressed or shortened; and so on with each.*

39. In conclusion, we would briefly observe that we think a careful perusal of all that has been gathered respecting Perpetual Motion clearly establishes that much remains to be done to prove the impossibility of practically solving this knotty problem; and that a full demonstration of the difficulties that environ it is worthy of being attempted, even by the most exalted mathematicians. It is not requisite that they should descend to the level of the most ordinary minds, but leave it for others to reduce their elaborated reasoning on the subject to some generally comprehensible form. We fear the proposal partakes too much of the difficulty of proving a negative; but still, as the attempt has been made by celebrated savans, and is generally considered insufficient; and as data may have been wanting, which we conceive a collection of the chief known examples will supply; we recommend the consideration of this matter to all geometers. In his Lives of the Poets, Dr. Johnson characterises the "Dunciad" as a work "of which the design is to ridicule such studies as are either hopeless or useless, as either pursue what is unattainable, or what, if it be attained, is of no use."

* The spokes can only slide up or down while *vertical*, in consequence of a ring or rim around them, placed to act as a shoulder against the axle, so long as the spokes are inwards, and *not* in a vertical position; otherwise they would act at an angle of 45°. The shoulder of each spoke is small enough to slip freely through the hole in which it slides in the axle, when the same becomes vertical during rotation.

It is difficult to surmise to what extent Pope thus benefitted literature; but it is certain that all the minor "Dunciads," in lashing Perpetual Motion, have failed to rid Natural Philosophy of many misgivings respecting its feasibility; and it is either *impossible*, and the Marquis of Worcester was himself strangely deceived; or it may be *possible*, and the noble inventor of the steam-engine remain worthy of his high character as a truthful narrator of facts: quite incapable of misrepresenting, much less elaborately falsifying them. In a mathematical point of view, we think this subject is far from being exhausted; and, after what has been advanced, may very properly be considered as claiming grave consideration. And that, scientifically examined, it is a mark of mere shallowness and querulousness to attempt the substitution of ridicule and satire for the more difficult, but consistent course of sound, close reason and argument, such as the wonted sobriety and severity of scientific criticism accords to its investigations generally.

*** The printing of this work had progressed too far to introduce, in its proper place, the demonstration of Professor Airy in favour of Perpetual Motion being possible. It is taken from a copy of the Cambridge Philosophical Society's Transactions, in the British Museum, and forms the last article in the Addenda.

PERPETUUM MOBILE;

OR,

SEARCH FOR SELF-MOTIVE POWER.

CHAPTER I.

EARLY OPINIONS RESPECTING THE POSSIBILITY OF, AND PROJECTS FOR OBTAINING, PERPETUAL MOTION.

JOHN WILKINS, an ingenious and learned Bishop of Chester, was born near Daventry, in Northamptonshire, in 1614, and died 1672. He was well versed in mechanical science, and his writings display an extensive acquaintance with a variety of ancient authorities on every matter on which he discourses. He is the most exact writer of the seventeenth century on the subject of Perpetual Motion, examining it thoroughly, with admirable acuteness as well as candour. His celebrated work, entitled "Mathematical Magic," is divided into two books, the second quaintly designated "Dædalus," after that ancient inventor. Among the works he has briefly quoted in marginal notes, we may mention more at large—"A Treatise on Continuall Motions, by JOANNES TAISNIERUS, a public Professor of Rome, Ferraria, and other Vniuersities in Italie" —no date, but afterwards printed with other works, 1579,

quarto. Also "A Dialogue concerning Perpetual Motion, by THOMAS TYMME, Mynister," London, 1612, quarto. He does not, however, allude to another of the same period, "De Inventione Æterni Motoris, by JAMES ZABARELLA, Teacher of Logic at Padua," where he died 1589; his book was published at Francfort, 1618. The ninth, thirteenth, fourteenth, and fifteenth chapters of Bishop Wilkins' work, second book, here follow:—

CHAP. IX.—*Of a Perpetual Motion—The seeming facility and real difficulty of any such contrivance—The several ways whereby it hath been attempted, particularly by Chymistry.*

It is the chief inconvenience of all the automata beforementioned,* that they need a frequent repair of new strength, the causes whence their motion does proceed being subject to fail, and come to a period; and therefore it would be worth our enquiry to examine whether or no there may be made any such artificial contrivance, which might have the principle of moving from itself, so that the present motion should constantly be the cause of that which succeeds.

This is that great secret in Art which, like the Philosopher's Stone in Nature, hath been the business and study of many more refined wits, for divers ages together; and it may well be questioned whether either of them as yet hath ever been found out; though if this have, yet, like the other, it is not plainly treated of by any author.

Not but there are sundry discourses concerning this subject, but they are rather *conjectures* than *experiments*. And though many inventions in this kind may at first view bear a great shew of probability, yet they will fail, being brought to trial, and will not answer in practice what they promised in speculation. Any one who hath been versed in these experiments must needs acknowledge that he hath been often deceived in his strongest confidence; when the imagination hath contrived the whole frame of such an instrument, and conceives that the event must infallibly answer its hopes, yet then does it strangely deceive in the proof, and discovers to us some defect which we did not before take notice of.

* Various mills, chariots, clocks, &c., &c.

Hence it is, that you shall scarce talk with any one who hath never so little smattering in these arts, but he will instantly promise such a motion, as being but an easy atchievement, till further trial and experience hath taught him the difficulty of it. There being no enquiry that does more entice with the *probability* and deceive with the *subtilty*.

I shall briefly recite the several ways whereby this hath been attempted, or seems most likely to be effected, thereby to contract and facilitate the enquiries of those who are addicted to these kind of experiments; for when they know the defects of other inventions, they may the more easily avoid the same or the like in their own.

The ways whereby this hath been attempted may be generally reduced to these three kinds:—

1. By Chymical Extractions.
2. By Magnetical Virtues.
3. By the Natural Affection of Gravity.

1. The discovery of this hath been attempted by Chymistry. Paracelsus and his followers have bragged, that by their separations and extractions, they can make a little world which shall have the same perpetual motions with this microcosm, with the representation of all meteors, thunder, snow, rain, the courses of the sea in its ebbs and flows, and the like. But these miraculous promises would require as great a faith to believe them, as a power to perform them; and tho' they often talk of such great matters,—

> At nusquam totos inter qui talia curant,
> Apparet ullus, qui re miracula tanta
> Comprobet—

yet we can never see them confirmed by any real experiment; and then, besides, every particular author in that art hath such a distinct language of his own (all of them being so full of allegories and affected obscurities), that 'tis very hard for any one (unless he be thoroughly versed amongst them) to find out what they mean, much more to try it.

One of these ways (as I find it set down) is this:—Mix five ounces of ☿ with an equal weight of ♃; grind them together with ten ounces of sublimate; dissolve them in a cellar upon some marble for the space of four days, till they become like oil olive; *Etten. Mathem. Recreat.,prob.*118.

distil this with fire of chaff, or driving fire, and it will sublime into a dry substance; and so, by repeating of these dissolvings and distillings, there will be at length produced divers small attoms, which, being put into a glass well luted, and kept dry, will have a perpetual motion.

I cannot say any thing from experience against this; but methinks it does not seem very probable, because things that are forced up to such a vigorousness and activity as these ingredients seem to be by their frequent sublimings and distillings, are not likely to be of any duration. The more any thing is stretched beyond its usual nature, the less does it last; violence and perpetuity being no companions. And then, besides, suppose it true, yet such a motion could not well be applied to any use, which will needs take much from the delight of it.

Celebrated in an epigram by Hugo Grotius, l. 1.

Amongst the chymical experiments to this purpose, may be reckoned up that famous motion invented by Cornelius Dreble, and made for King James; wherein was represented the constant revolutions of the sun and moon, and that without the help either of springs or weights. Marcellus Vranckhein, speaking of the means whereby it was performed, he calls it *Scintillula animæ magneticæ mundi, seu astralis et insensibilis spiritus;* being that grand secret, for the discovery of which, those dictators of philosophy, Democritus, Pythagoras, Plato, did travel unto the Gymnosophists and Indian Priests. The author himself, in his discourse upon it, does not at all reveal the way how it was performed. But there is one Thomas Tymme, who was a familiar acquaintance of his, and did often pry into his works (as he professes himself), who affirms it to be done thus: By extracting a fiery spirit out of the mineral matter, joining the same with his proper air, which included in the axletree (of the first moving wheel), being hollow, carrieth the other wheels, making a continual rotation, except issue or vent be given in this hollow axletree, whereby the imprisoned spirit may get forth.

Epist. ad Ernestum de Lamp. Vitæ.

Epist. ad Jacoum Regem.

Philosoph. Dialogue, confer. 2, c. 3.

What strange things may be done by such extractions, I know not, and therefore dare not condemn this relation as impossible; but methinks it sounds rather like a chymical

dream, than a philosophical truth. It seems this imprisoned spirit is now set at liberty, or else is grown weary, for the instrument (as I have heard) hath stood still for many years. It is here considerable that any force is weakest near the center of a wheel; and therefore, though such a spirit might of itself have an agitation, yet 'tis not easily conceivable how it should have strength enough to carry the wheels about with it. And then, the absurdity of the author's citing this, would make one mistrust his mistake. He urges it as a strong argument against Copernicus; as if, because Dreble did thus contrive in an engine the revolution of the heavens and the immoveableness of the earth, therefore it must needs follow that 'tis the heavens which are moved, and not the earth. If his relation were no truer than his consequence, it had not been worth the citing.

CHAP. XIII.—*Concerning several attempts of contriving a Perpetual Motion, by Magnetical Virtues.*

The second way whereby the making of a perpetual motion hath been attempted, is by Magnetical Virtues, which are not without some strong probabilities of proving effectual to this purpose; especially when we consider that the heavenly revolutions (being as the first pattern imitated and aimed at in these attempts) are all of them performed by the help of these qualities. This great orb of earth, and all the other planets, being but as so many magnetical globes, endowed with such various and continual motions as may be most agreeable to the purposes for which they were intended. And, therefore, most of the authors who treat concerning this invention, do agree that the likeliest way to effect it, is by these kind of qualities.

Gilbert de Magnet. Cabœus Philos. Magnet., l. 4, c. 20.

It was the opinion of Pet. Peregrinus, and there is an example pretended for it in Bettinus (apiar. 9, progym. 5, pro. 11) that a magnetical globe, or terella, being rightly placed upon its poles, would of itself have a constant rotation, like the diurnal motion of the earth. But this is commonly exploded as being against all experience.

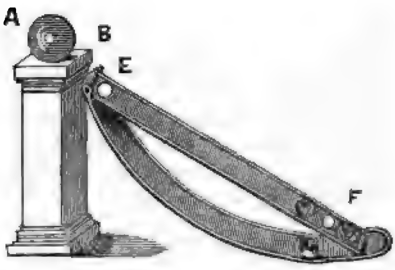
Athanas. Kircher de Arte Magnet., l. 1, par. 2, prop. 13. Item., l. 2, p. 4.

Others think it possible so to contrive several pieces of steel and loadstone that, by their continual attraction and

a. Tract. de motu continuo.
b. De Rota perpetui motus, par. 2, c. 3.
c. De Variet. rerum, l. 9, c. 48.
De Magnet., l. 2, c. 25.

expulsion of one another, they may cause a perpetual revolution of a wheel. Of this opinion were [a] Taisner, [b] Pet. Peregrinus, and [c] Cardan, out of Antonius de Fantis. But D. Gilbert, who was more especially versed in magnetical experiments, concludes it to be a vain and groundless fancy.

But amongst all these kinds of inventions, that is most likely, wherein a loadstone is so disposed that it shall draw unto it on a reclined plane a bullet of steel, which steel, as it ascends near to the loadstone, may be contrived to fall down through some hole in the plane, and so to return unto the place from whence at first it began to move; and, being there, the loadstone will again attract it upwards till coming to this hole, it will fall down again; and so the motion shall be perpetual, as may be more easily conceivable by this figure :—



Suppose the loadstone to be represented at A B, which, though it have not strength enough to attract the bullet C directly from the ground, yet may do it by the help of the plane E F. Now, when the bullet is come to the top of this plane, its own gravity (which is supposed to exceed the strength of the loadstone) will make it fall into that hole at E; and the force it receives in this fall will carry it with such a violence unto the other end of this arch, that it will open the passage which is there made for it, and by its return will again shut it; so that the bullet (as at the first) is in the same place whence it was attracted, and, consequently, must move perpetually.

But however this invention may seem to be of such strong probability, yet there are sundry particulars which may prove it insufficient: for—

1. This bullet of steel must first be touched, and have its several poles, or else there can be little or no attraction of it. Suppose C in the steel to be answerable unto A in the stone, and to B; in the attraction C D must always be directed answerable to A B, and so the motion will be more difficult; by reason there can be no rotation or turning round of the bullet, but it must slide up with the line C D, answerable to the axis A B.

2. In its fall from E to G, which is *motus elementaris*, and proceeds from its gravity, there must needs be a rotation of it; and so 'tis odds but it happens wrong in the rise, the poles in the bullet being not in the same direction to those in the magnet; and if in this reflux it should so fall out, that D should be directed towards B, there should be rather a flight than an attraction, since those two ends do repel, and not draw one another.

3. If the loadstone A B have so much strength, that it can attract the bullet in F, when it is not turned round, but does only slide upon the plane, whereas its own gravity would rowl it downwards; then it is evident the sphere of its activity and strength would be so increased when it approaches much nearer, that it would not need the assistance of the plane, but would draw it immediately to itself without that help; and so the bullet would not fall down through the hole, but ascend to the stone, and, consequently, cease its motion: for, if the loadstone be of force enough to draw the bullet on the plane, at the distance F B, then must the strength of it be sufficient to attract it immediately unto itself, when it is so much nearer as E B. And if the gravity of the bullet be supposed so much to exceed the strength of the magnet, that it cannot draw it directly when it is so near, then will it not be able to attract the bullet up the plane, when it is so much further off.

So that none of all these magnetical experiments, which have been as yet discovered, are sufficient for the effecting of a perpetual motion, though these kind of qualities seem most conducible unto it; and perhaps, hereafter, it may be contrived from them.

CHAP. XIV.—*The seeming probability of effecting a Continual Motion by Solid Weights in a Hollow Wheel or Sphere.*

The third way whereby the making of a perpetual motion hath been attempted is by the Natural Affection of Gravity; when the heaviness of several bodies is so contrived, that the same motion which they give in their descent, may be able to carry them up again.

But (against the possibility of any such invention) it is thus objected by Cardan:—All sublunary bodies have a direct motion either of ascent or descent; which, because it does not refer to some term, therefore cannot be perpetual, but must needs cease when it is arrived at the place unto which it naturally tends.

Subtil., l. 17. De Var. Rerum, l. 9, c. 48.

I answer, though this may prove that there is no natural motion of any particular heavy body which is perpetual, yet it doth not hinder, but that it is possible from them to contrive such an artificial revolution as shall constantly be the cause of itself.

Those bodies which may be serviceable to this purpose are distinguishable into two kinds:—

1. Solid and consistent; as weights of metal, or the like.
2. Fluid or sliding; as water, sand, &c.

Both these ways have been attempted by many, though with very little or no success. Other men's conjectures in this kind you may see set down by divers authors. It would be too tedious to repeat them over, or set forth their draughts.

D. Flud. Tract. 2, par. 7, l. 2, c. 4 & 7.

I shall only mention two new ones, which (if I am not over-partial) seem altogether as probable as any of these kinds that have been yet invented; and, till experience had discovered their defect and insufficiency, I did certainly conclude them to be infallible.

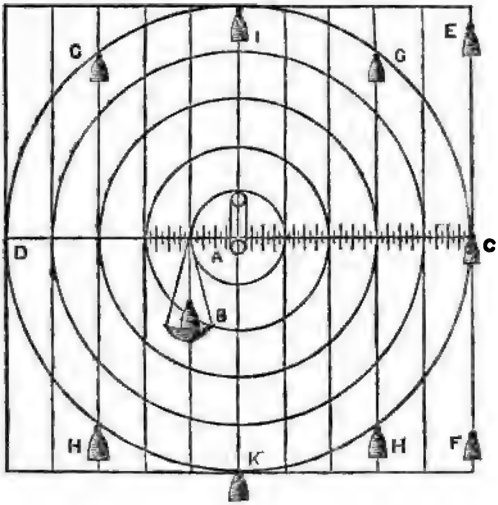
The first of these contrivances was by solid weights being placed in some hollow wheel or sphere, unto which they should give a perpetual revolution; for, as the philosopher hath largely proved, only a circular motion can properly be perpetual.

Arist. Phys., l. 8, c. 12.

But, for the better conceiving of this invention, it is requisite that we rightly understand some principles in Trochilicks, or the art of wheel instruments; as, chiefly, the relation betwixt the parts of a wheel and those of a ballance; the several proportions in the semi-

Arist. Mechan., c. 2. De ration. libræ ad circulu.

diameter of a wheel being answerable to the sides in a ballance, where the weight is multiplied according to its distance from the center.

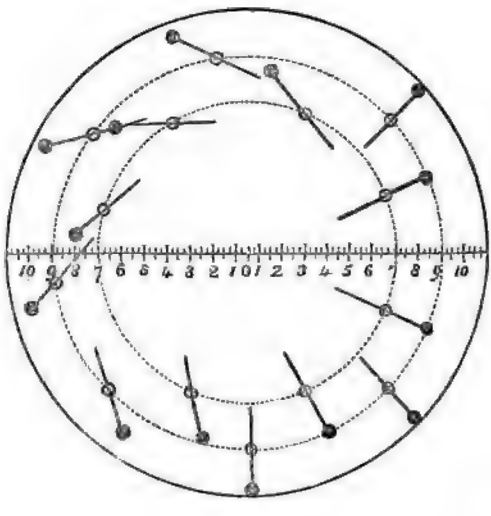


Thus, suppose the center to be at A, and the diameter of the wheel, D C, to be divided into equal parts (as is here expressed), it is evident, according to the former ground, that one pound at C will equiponderate to five pound at B, because there is such a proportion betwixt their several distances from the center. And it is not material whether or no these several weights be placed horizontally; for though B do hang lower than C, yet this does not at all concern the heaviness; or though the plummet C were placed much higher than it is at E, or lower at F, yet would it still retain the same weight which it had at C; because these plummets (as in the nature of all heavy bodies), do tend downwards by a strait line; so that their several gravities are to be measured by that part of the horizontal semidiameter which is directly either below or above them. Thus, when the plummet C shall be moved either to G or H, it will lose one-third of its former heaviness, and be equally ponderous as if it were placed in the ballance at number 3; and if we suppose it to be situated at

I or K, then the weight of it will lie wholly upon the center, and not at all conduce to the motion of the wheel on either side; so that the strait lines which pass through the divisions of the diameter may serve to measure the heaviness of any weight in its several situations.

These things thoroughly considered, it seems very possible and easie for a man to contrive the plummets of a wheel, that they may be always heavier in their fall, than in their ascent; and so, consequently, that they should give a perpetual motion to the wheel itself; since it is impossible for that to remain unmoved as long as one side in it is heavier than the other.

For the performance of this, the weights must be so ordered—1. That in their descent they may fall from the center, and in their ascent may rise nearer to it. 2. That the fall of each plummet may begin the motion of that which should succeed it, as in the following diagram:—



Where there are sixteen plummets, eight in the inward circle, and as many in the outward. (The inequality being to arise from their situation, it is therefore most convenient that the number of them be even.) The eight inward plummets are

supposed to be in themselves so much heavier than the other, that in the wheel they may be of equal weight with those above them, and then the fall of these will be of sufficient force to bring down the other. For example, if the outward be each of them four ounces, then the inward must be five; because the outward is distant from the center five of those parts whereof the inward is but four. Each pair of these weights should be joined together by a little string or chain, which must be fastened about the middle, betwixt the bullet and the center of that plummet which is to fall first, and at the top of the other.

When these bullets, in their descent, are at their farthest distance from the center of the wheel, then shall they be stopped, and rest on the pins placed to that purpose; and so, in their rising, there must be other pins to keep them in a convenient posture and distance from the center, lest, approaching too near unto it, they thereby become unfit to fall when they shall come to the top of the descending side.

This may be otherwise contrived with some different circumstances, but they will all redound to the same effect. By such an engine it seems very probable that a man may produce perpetual motion; the distance of the plummets from the center increasing with weight on one side, and their being tied to one another, causing a constant succession in their falling.

But now, upon experience, I have found this to be fallacious; and the reason may sufficiently appear by a calculation of the heaviness of each plummet, according to its several situation; which may easily be done by those perpendiculars that cut the diameter, (as was before explained, and is here expressed in five of the plummets on the descending side). From such a calculation it will be evident, that both the sides of this wheel will equiponderate; and so consequently, that the supposed inequality whence the motion should proceed, is but imaginary and groundless. On the descending side, the heaviness of each plummet may be measured according to these numbers, (supposing the diameter of the wheel to be divided into twenty parts, and each of those subdivided into four):—

THE OUTWARD PLUMMETS.		THE INWARD PLUMMETS.	
7.0 10.0 7.0	The sum 24.	1.0 7.2 7.2 3.0	The sum 19.

On the ascending side, the weights are to be reckoned according to these degrees:—

THE OUTWARD.		THE INWARD.	
1.3 7.2 9.0 5.3 0.0	The sum 24.	4.1 7.0 5.2 2.1	The sum 19.

The sum of which last numbers is equal with the former, and therefore both the sides of such a wheel in this situation will equiponderate.

If it be objected, that the plummet A should be contrived to pull down the other at B, and then the descending side will be heavier than the other; for answer to this, it is considerable—

1. That these bullets towards the top of the wheel, cannot descend till they come to a certain kind of inclination.

2. That any lower bullet hanging upon the other above it, to pull it down, must be conceived, as if the weight of it were in that point where its string touches the upper; at which point this bullet will be of less heaviness in respect of the wheel, than if it did rest in its own place; so that both the sides of it, in any kind of situation, may equiponderate.

CHAP. XV.—*Of composing a Perpetual Motion by Fluid Weights—Concerning Archimedes his Water Screw—The great probability of accomplishing this enquiry by the help of that, with the fallibleness of it upon experiment.*

That which I shall mention as the last way, for the trial of this experiment, is by contriving it in some Water Instrument; which may seem altogether as probable and easie as any of the rest; because that element, by reason of its fluid and subtle nature (whereby, of its own accord, it searches out the lower and more narrow passages), may be most pliable to the mind of the artificer. Now, the usual means for the ascent of water is either by suckers or forces, or something equivalent thereunto; neither of which may be conveniently applied unto such a work as this, because there is required unto each of them so much or more strength, as may be answerable to the full weight of the water that is to be drawn up; and then, besides, they move for the most part by fits and snatches, so that it is not easily conceivable, how they should conduce

unto such a motion, which, by reason of its perpetuity, must be regular and equal.

But, amongst all other ways to this purpose, that invention of Archimedes is incomparably the best, which is usually called *Cochlea*, or the Water Screw; being framed by the helical revolution of a cavity about a cylinder. We have not any discourse from the author himself concerning it, nor is it certain whether he ever writ anything to this purpose; but if he did, yet, as the injury of time hath deprived us of many other his excellent works, so likewise of this amongst the rest.

[Near five pages are occupied in describing the use of this screw, and the form and manner of making it; then follows :—]

The true inclination of the screw being found, together with the certain quantity of water which every helix does contain; it is further considerable, that the water by this instrument does ascend naturally of itself, without any violence or labour; and that the heaviness of it does lie chiefly upon the centers or axis of the cylinder, both its sides being of equal weight (saith Ubaldus); so that, it should seem, though we suppose each revolution to have an equal quantity of water, yet the screw will remain with any part upwards, according as it shall be set, without turning itself either way; and, therefore, the least strength being added to either of its sides should make it descend, according to that common maxim of Archimedes—any addition will make that which equiponderates with another to tend downwards.

Ubaldus de Cochlea, l.3, prop.4.

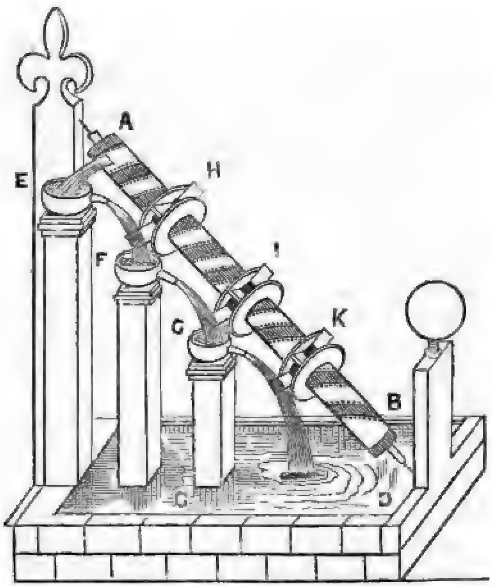
De Æquipond. Suppos. 3.

But now, because the weight of this instrument and the water in it does lean wholly upon the axis, hence is it (saith Ubaldus) that the grating and rubbing of these axes against the sockets wherein they are placed, will cause some ineptitude and resistency to that rotation of the cylinder; which would otherwise ensue upon the addition of the least weight to any one side; but (saith the same author) any power that is greater than this resistency which does arise from the axis, will serve for the turning of it round.

These things considered together, it will hence appear how a perpetual motion may seem easily contrivable. For, if there were but such a water-wheel made on this instrument, upon which the stream that is carried up may fall in its descent, it would turn the screw round, and by that means convey as

much water up as is required to move it; so that the motion must needs be continual, since the same weight which in its fall does turn the wheel is, by the turning of the wheel, carried up again.

Or, if the water, falling upon one wheel, would not be forcible enough for this effect, why then there might be two or three, or more, according as the length and elevation of the instrument will admit; by which means the weight of it may be so multiplied in the fall that it shall be equivalent to twice or thrice that quantity of water which ascends; as may be more plainly discerned by the following diagram:—



Where the figure L M, at the bottom, does represent a wooden cylinder with helical cavities cut in it, which at A B is sup-

posed to be covered over with tin plates, and three water-wheels upon it, H I K; the lower cistern, which contains the water, being C D. Now, this cylinder being turned round, all the water which from the cistern ascends through it, will fall into the vessel at E, and from that vessel being conveyed upon the water-wheel H, shall consequently give a circular motion to the whole screw. Or, if this alone should be too weak for the turning of it, then the same water which falls from the wheel H, being received into the other vessel F, may from thence again descend on the wheel I, by which means the force of it will be doubled. And if this be yet unsufficient, then may the water which falls on the second wheel I, be received into the other vessel G, and from thence again descend on the third wheel at K; and so for as many other wheels as the instrument is capable of. So that, besides the greater distance of these three streams from the center or axis by which they are made so much heavier, and besides that the fall of this outward water is forcible and violent, whereas the ascent of that within is natural,—besides all this, there is thrice as much water to turn the screw as is carried up by it.

There is another like contrivance to this purpose in Pet. Bettin., apiar. 1, pogym. 1, prop. 10, but with much less advantage than 'tis here proposed.

But, on the other side, if all the water falling upon one wheel would be able to turn it round, then half of it would serve with two wheels, and the rest may be so disposed of in the fall as to serve unto some other useful delightful ends.

When I first thought of this invention, I could scarce forbear, with Archimedes, to cry out ἕυρηκα, ἕυρηκα; it seeming so infallible a way for the effecting of a perpetual motion that nothing could be so much as probably objected against it; but, upon trial and experience, I find it altogether insufficient for any such purpose, and that for these two reasons:—

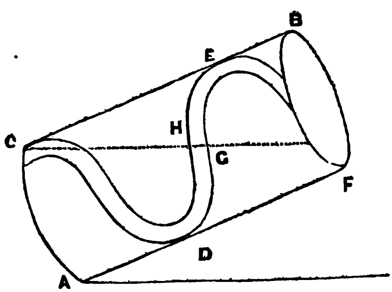
1. The water that ascends will not make any considerable stream in the fall.

2. This stream, tho' multiplied, will not be of force enough to turn about the screw.

1. The water ascends gently, and by intermissions; but it falls continually, and with force; each of the three vessels being supposed full at the first, that so the weight of the water in them might add the greater strength and swiftness to the streams that descend from them. Now, this swiftness of motion will cause so great a difference betwixt them that

one of these little streams may spend more water in the fall than a stream six times bigger in the ascent, tho' we should suppose both of them to be continuate; how much more, then, when as the ascending water is vented by fits and intermissions, every circumvolution voiding so much as is contained in one helix; and, in this particular, one that is not versed in these kind of experiments may be easily deceived.

But, secondly, tho' there were so great a disproportion, yet, notwithstanding, the force of these outward streams might well enough serve for the turning of the screw, if it were so that both its sides would equiponderate the water being in them (as Ubaldus hath affirmed). But now, upon farther examination, we shall find this assertion of his to be utterly against both reason and experience. And herein does consist the chief mistake of this contrivance; for the ascending side of the screw is made, by the water contained in it, so much heavier than the descending side, that these outward streams, thus applied, will not be of force enough to make them equiponderate, much less to move the whole, as may be more easily discern'd by this fig.:—



Where A B represents a screw covered over, C D E one helix or revolution of it, C D the ascending side, E D the descending side, the point D the middle; the horizontal line C F shewing how much of the helix is filled with water, viz., of the ascending side, from C the beginning of the helix, to D the middle of it; and on the descending side, from D the middle, to the point G, where the horizontal does cut the helix. Now, it is evident that this latter part, D G, is

nothing near so much, and consequently not so heavy as the other, D C; and thus is it in all the other revolutions, which, as they are either more or larger, so will the difficulty of this motion be increased. Whence it will appear that the outward streams which descend must be of so much force as to countervail all that weight whereby the ascending side in every one of these revolutions does exceed the other. And tho' this may be effected by making the water-wheels larger, yet then the motion will be so slow that the screw will not be able to supply the outward streams.

There is another contrivance to this purpose, mentioned by Kircher de Magnete, l. 2, p. 4, depending upon the heat of the sun and the force of winds; but it is liable to such abundance of exceptions that it is scarce worth the mentioning, and does by no means deserve the confidence of any ingenious artist.

Thus have I briefly explained the probabilities and defects of those subtle contrivances whereby the making of a perpetual motion hath been attempted. I would be loth to discourage the enquiry of any ingenious artificer by denying the possibility of effecting it with any of these mechanical helps; but yet (I conceive) if those principles which concern the slowness of the power in comparison to the greatness of the weight were rightly understood and thoroughly considered, they would make this experiment to seem, if not altogether impossible, yet much more difficult than otherwise, perhaps, it will appear. However, the enquiring after it cannot but deserve our endeavours, as being one of the most noble amongst all these mechanical subtilties. And, as it is in the fable of him who dug the vineyard for a hid treasure, tho' he did not find the money, yet he thereby made the ground more fruitful, so, tho' we do not attain to the effecting of this particular, yet our searching after it may discover so many other excellent subtilties as shall abundantly recompence the labour of our enquiry.

And then, besides, it may be another encouragement to consider the pleasure of such speculations, which do ravish and sublime the thoughts with more clear angelical contentments. Archimedes was generally so taken up in the delight of these mathematical studies of this familiar siren (as Plutarch stiles them) that he forgot

'οικείας καὶ συνοίκου σειρῆνος. *Plutarch. Marcell. Joan. Tzetzes. Chil. 2, Hist. 35. Valer. Maxim. l. 8, c. 7.*

D

both his meat and drink, and other necessities of nature; nay, that he neglected the saving of his life, when that rude soldier, in the pride and haste of victory, would not give him leisure to finish his demonstration. What a ravishment was that, when, having found out the way to measure Hiero's crown, he leaped out of the bath, and (as if he were suddenly possess'd) ran naked up and down, crying *εὕρηκα, εὕρηκα!* It is storied of Thales that, in his joy and gratitude for one of these mathematical inventions, he went presently to the Temple, and there offered up a solemn sacrifice; and Pythagoras, upon the like occasion, is related to have sacrificed a hundred oxen; the justice of Providence having so contrived it, that the pleasure which there is in the success of such inventions should be proportioned to the great difficulty and labour of their enquiry.*

OF CONTINUAL MOTION. By JOANNES TAISNIERUS; prior to 1579.—In the library of the British Museum is an edition of "A very necessarie & profitable booke concerning Nauigation, compiled in Latin by Joannes Taisnierus, a public professor in Rome, Ferraria, and other universities in Italie of the Mathematicalles, named a Treatise of Continuall Motions; translated into English by Richard Eden." It is a black letter quarto tract, printed by Richard Jugge, without date, consisting of eighty-two pages. The first part is "Of the vertue of the Loadstone," and the second part is "Of continual motion by the said stone Magnes." It was reprinted 1579. In his introductory remarks, he observes, in allusion to continual motion, that it is—

The thing which to this day in manner from the beginning of the world, great philosophers with perpetual studie and great labour, have endeavoured to bring to effect, and desired end, hath neverthelesse hitherto remayned eyther unknown or hydde, not without great damage & hynderance of most expert mathematicians.

* Mathematical Magick, in two books, by Bishop Wilkins. 8vo. 1707. Fifth edition. Book ii., called Dædalus; or, Mechanical Motions.

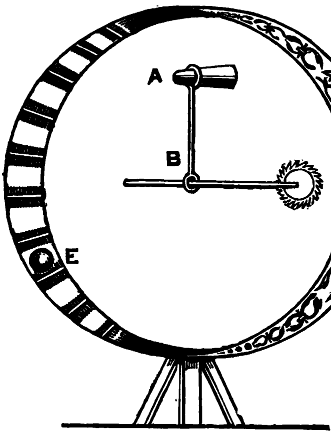
Referring now to the second part, we read :—

From the begynnyng of the worlde, in manner all naturall philosophers & mathematitians, with great expences and labour, have attempted to fynde out a continuall motion or moovyng: yet unto this day have few or none atteyned to the true ende of their desyre. They have attempted to doo this with divers instrumentes & wheeles, & with quicksylver, not knowyng the vertue of this stone. Neyther can continual motion be founde by anye other meanes, then by the stone Magnes, in this maner. Make a holowe case of sylver, after the fashion of a concave glasse, outwardly laboured with curious art of gravyng, not onely for ornament, but also for lyghtnesse; the lyghter that it is, so much the more eassyer shal it be mooved, neyther must it be so pearced through, that such as are ignorant of the hyd secrete, may easyly perceyve it.

["The fourme of the stone" is here engraved.]

It must have on the inner syde certayne litle nayles & denticles or smal teeth of iron of one equal weyght, to be fastened on the border or margent, so that the one be no further distant from the other, then is the thycknesse of a beane or chicke pease. The sayd wheele also must be in all partes of equall weyght, then fasten the exiltree in the myddest, upon the whiche the wheele may turne, the exiltree remaynyng utterly immoveable. To the whiche exiltree agayne shal be joyned a pynne of sylver, fastened to the same, & placed betweene the two cases in the hyghest parte, whereon place the stone Magnes. Beyng thus prepared let it be fyrste brought to a rounde fourme, then (as is sayd) let the poles be founde: then the poles untouched, the two contrarye sydes lying betweene the poles, must be fyled & pullyshed, & the stone brought in maner to the fourme of an egge, & somewhat narower in those two sydes, lest the lower parte thereof shoulde occupie the inferior place, that it may touche the walles of the case lyke a litle wheele. This done, place the stone upon the pynne, as a stone is fastened in a ryng, with such art, that the north pole may a litle enclyne toward the denticles, to the ende that the vertue thereof woorke not directly his impression, but with a certayne inclination geve his influence upon the denticles of iron. Every denticle therefore shall come to the north pole, & when by force of the wheele it shall somewhat passe that pole, it shall come to the

south part, whiche shall dryve it backe agayne; whom then agayne the pole artike shall drawe as appeareth. And that the wheele may the sooner doo his office within the cases, inclose therein a litle calculus (that is) a litle rounde stone or



pellet of copper or sylver, of suche quantitie, that it may commodiously be receyved within any of the denticles: then when the wheeles shal be raysed up, the pellet or rounde weyght shal fal on the contrary parte. And whereas the motion of the wheele downwarde to the lowest part, is perpetuall, & the fall of the pellet, opposite or contrary, ever receyved within any two of the denticles, the motion shall be perpetuall, because the weyght of the wheele & pellet ever enclyneth to the centre of the earth, & lowest place. Therefore when it shal permit the denticles to rest about the stone, then shall it well serve to the purpose. The myddle places within the denticles ought so artificially to be made belowe, that they may aptly receive the fallyng pellet or plommet, as the fygure above declareth. And briefly to have wrytten thus much of continuall motion may suffice.

Description of the Engraving—A, the stone; B, the silver pinne; E, calculus, a little rounde stone or small weyght.

Perpetual Motion.—In the "Theatrum Machinarum Generale," by Jacob Leupold, published at Leipsic, 1724, folio, appears an article, of which the following is a free and abridged translation:—

The so-called machine to produce perpetual motion consists of a proper adjustment of weights. Such a machine is one that without external power would have a continual movement of its own, as long as its materials last. The search after this movement has become so general in the present day (prior to 1724), that the humblest mechanics enthusiastically express certainty of their ability, had they time and money, to produce something of the kind to surprise the world. However, is there any subject after which so many thousands have longed, spent their money, industry, and time, as this same perpetual motion? Dr. Becher has eight dissimilar inventions, all of which have interested the scientific world, one of the number being perpetual motion. Although the discovery of making gold would be the most honourable and praiseworthy thing in the world, yet not even that has been so sought after as perpetual motion; because the one requires a high knowledge of chemistry, and the other merely requiring that a certain weight at a distance from the axletree, should fall and rise without losing its power; and it is here so many inventors have been deceived, from wanting proper mechanical knowledge. The machines most hopeful are those given in Figures 10 and 11.

[For engravings and full account, see Appendix A.]

The action of the foregoing plans, in each, tends to find the centre of gravity, and therefore after many trials were all found to cease movement.

It still remains to find out this wonderful and undiscovered thing, which to the present time remains impossible both mathematically and mechanically, so far as we yet know. Great weight only increases friction, but there was a wheel or machine that did not weigh above forty pounds, and was nine feet diameter, which promised better results, yet failed like others, and so dissipated all hope of succeeding.

Notwithstanding we hold that perpetual motion is not an impossibility, as has been shown to all the world by Coun-

cillor Orffyreus, and attested by the princely word of the Landgrave of Hesse Cassel, a prince himself well grounded in the science of mechanics, and who so minutely scrutinised and observed this wonderful motion, which was with him on trial during two months; all of which time he kept the machine in a sealed chamber.

To all the seekers after perpetual motion the following remarks will be found most valuable:—

1. That they must endeavour to construct one of the simplest of machines; for the more material and workmanship, the less chance of durability. And if not found in such simple arrangement, it will be hid for ever.

2. That it must be tried by experiment and not only on paper, for the friction and action can only be estimated by trial.

3. That unless grounded in the fundamental principles of mechanics, no one should attempt the project, as he will only lose time and money. The thousands who fail of success yet learn something of mechanics, and that one pound cannot move more than one pound, but always arrives at an equilibrium.*

PERPETUAL SYPHON AND MILL.—Leupold, in his "Theatrum Machinarum Generale," on Hydraulics, describes:—

The water-wheel of a mill operated by a syphon. The inventor has here endeavoured to gain perpetual motion by constructing a syphon which at A has more water than at B, consequently more weight; to lessen the waste of water at A, he makes the syphon smaller at its aperture; so that the weight of A and B are equalised. Water, however, is weighed not by its quantity but its height, hence this plan did not succeed in this, and many other instances; and it has been tried to the ruin of many. Modifications of the principle on which this syphon is constructed have been found, on experiment, equally false. In the work of Sinclari's "De Arte magna et nova gravitatis et levitatis," the subject of perpetual motion by means of mercury is very skilfully handled. But all these plans have circumstances attending them causing

* Vol. 1, par. 58.

their failure.—*From the first chapter of the first division on Hydraulics.*

[See Appendix B, for full account and engraving.]

Perpetual Pump.—In continuance of the same subject, but employing other means, Leupold describes:—

A machine with a water-snake (Archimedean screw) whereby perpetual motion was attempted.

There was a wheel made connected with a screw, and the water was to fall from the screw on the wheel. Several hands were occupied with great industry and earnestness on it for some years. A full description of this plan is to be found in Bettinus and in Peter Schotte's "Mechanica Hydraulica-Pneumatica;" but Bettinus, and especially Kircherus, have written to prove the impossibility of the method here proposed.

[For engraving and full description from Leupold's work, see Appendix C.]

Our next early authority on the subject under consideration is derived from "A History of Manual Arts, 1661," to the following effect:—

[After alluding to "Archimedes of Syracuse, the greatest mathematician and the rarest engineer that was in his time," who invented "a sphear and an artificial heaven, wherein he did represent the rotations and revolutions of the planets," and of which Claudian gives a poetic description—"that this machin did move of itself; it was an automaton, a self-moving device;" and further, "that these motions were driven and acted by certain spirits pent within;" also of another device of "a silver heaven sent by the Emperour Ferdinand for a present to Soliman the Grand Signior," with twelve men, and a book "that shewed the use of it, and how to order and keep it in perpetual motion,"—an account is next given of Cornelius van Drebble, a Dutchman, of Alcmar, engineer to King James, in England:—]

He presented the king with a rare instrument of perpetual motion, without the means of steel, springs, or weights; it was made in the form of a globe, in the hollow whereof were wheels of brass moving about, with two pointers on each side thereof, to proportion and shew forth the times of dayes, moneths, and years, like a perpetual almanack. (Page 19.)

At page 22 is an account of Fanellus Turrianus, a citizen of Cremona, who "did recreate the Emperour Charles the Fift (when he had resigned up his empire, and retired to a monastique life in Spain) with ingenious and rare devices;"—among others—

He framed a mill of iron that turned itself, of such subtile work & smalness, that a monk could easily hide it in his sleeve; yet would it daylie grinde so much wheat as would abundantly serve 8 persons for their day's allowance.*

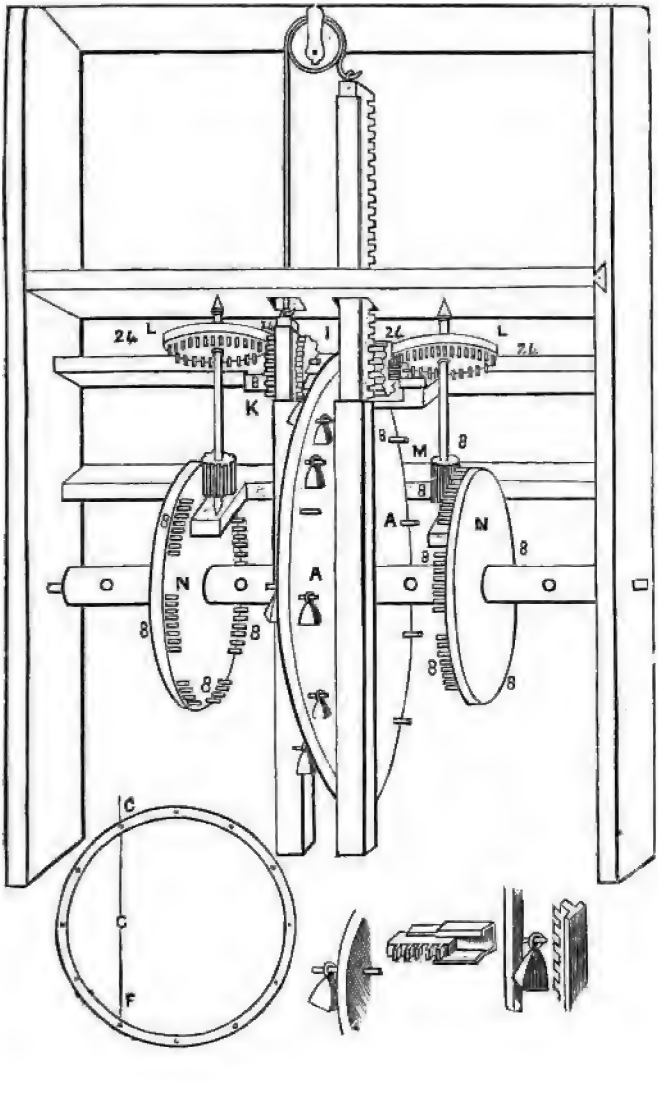
The next two articles we shall quote will be given in the original Latin version; the first from a folio edition of ROBERT FLUDD's works, 1618, as follows:—

De instrumento haud spernendo, quo quidam Helvetius motum perpetuum invenisse pro certo credebat. Estque speciei primæ rotarum differentiæ.

A. rota principalis. B. C. pondera unius lateris. D. E. F. pondera alterius lateris. G. baculus portator. H. sustinens baculum. I. rotula elevans. K. ejus pecten. L. corona. M. pecten corona. N. interfracta. O. arbor. P. orbiculus. Q. chorda. R. pondus 4 librarum.

Rota principalis hoc modo fit, scilicet, ut in 12. partes æquales dividatur in uno ac altero latere, & affigantur cuique lateri clavi 6. eâdem distantiâ ab invicem dispositi, sic tamen, ut quivis clavus stet in medio duorum aliorum ex altero latere rotæ, et non unus juxta alium: Appensis jam ponderibus 6. (quorum in quovis latere sunt 3. omnia tamen 6. in una parte rotæ citra centrum) reperitur hæc rota onerata pondere 15.

* Humane Industry; or, a History of most Manual Arts. 12mo. London, 1661. Pp. 14 to 23.



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librarum, quia pondus C. in recta linea habet lb. quatuor. D. E. circa 7. lb. B. F. autem 4. quæ simul aggregatæ efficiunt 15. lb. quemadmodum ex regulis prima primi cap. et prima ac secunda secundi cap. lib. primi patet.

Movetur jam rota, ita ut infimum pondus appropinquet clavo baculi portantis, qui positus juxta B. & F. recipit hoc pondus per uncum suum, ubi illi adhærenti portatur in altum, & rota inferiùs evacuata perget; interim appropinquat clavus proximus, qui sequitur B. & in eodem loco, ubi jam est B. recipit pondus sibi apportatum a baculo: Et ita semper oneratur rota in superiori & exoneratur in inferiori parte, quia semper, dum duodecima pars rotæ volvitur, baculum ascendere, et dum alia duodecima pars vertitur, iterùm eundem descendere necesse est. Elevatur autem baculus per rotulum L. quæ rotula ter vertendo attingit omnem altitudinem baculi, ipsum ad clavum usque desideratum elevans: Vertitur autem ejusmodi rotula per pectinem suum K. à corona L. quæ et ipsa per suum pectinem M. à rota interfracta N. semel volvitur, à quavis duodecima parte rotæ interfractæ O. semper dentes habentæ in duodecima sua parte superficiei, et hoc sexies habet enim alias intermedias vacuas ejusdem speciei ad relinquendum baculum, qui sponte sua cadere, et per casum suum rotulam Q. et coronam M. reverti cogit; Ne autem cadat cum impetu, suspensus est ad chordam Q. alteri baculo adhærentem, per orbiculum P. quia tantum, quantum unus baculus cadit, alter ascendit.

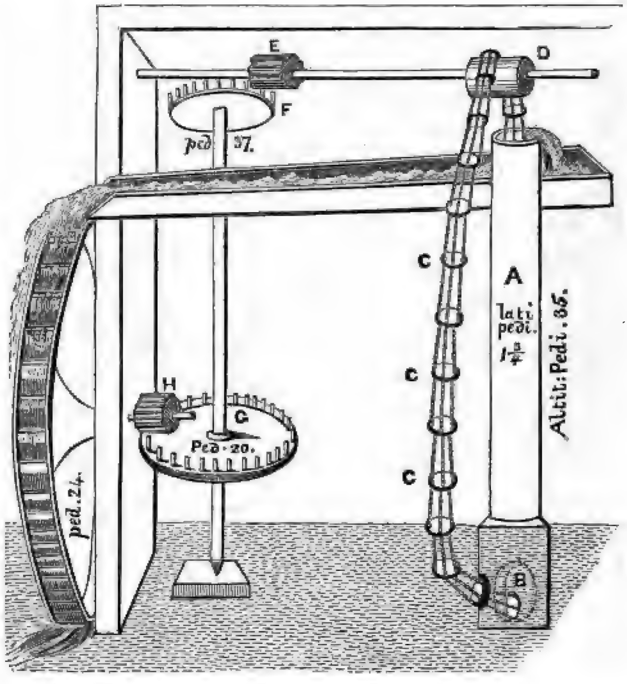
Rota interfracta affixa est arbori aut axi rotæ principalis, et ejus vi circumvolvitur. Quod autem similia instrumenta posita sunt ex alio rotæ principalis latere, eò fit, quod semper et continuo loboratur onerando et exonerando rotam, quia quando ex uno latere pondus aufertur, in alio appenditur. Et sic semper rota habet 5, pondera pendentia, et unum semper inascendente baculo.

Sed, quamvis hæc viri Helvetici theoria sit satis ingeniosa aud probabilis quod 5. pondera inhærentia rotæ unum pondus facilè trahere et elevare deberent; Attamen, quia vis non est proportionata ad tempus, nihil hîc efficitur, quia ascendens pondus pertransire debet per pondera 5. aut per spatium tot partium, quarum unicâ ipsum movetur, unicum pondus ascendens tantum perdurat, quantum cætera quinque ratione longi transitus. Ergo seipsum superare nequit.

Hanc Ingeniatoris Helvetici inventionem ejúsque errorem

hoc loco descripsimus, ut hujus scientiæ curiosi majori diligentia proportionum cognitionem perscutentur, easq́ue sedulò observent.

De alia bona inventione ad aquas facilè elevandas, quo quidam Italus se motum perpetuum invenisse jactitare ausus est.



INSTRUMENTI DESCRIPTIO.

LITERARUM EXPLICATIO.

A. haustrum seu pompa.

B. rotula affixa in haustrifundo, super quam pistella, sive rotunda ex corio conflata leviter circumvolvuntur, ut facilius sursum tendant; repleturque uncis ferreis.

C. C. C. pistella seu rotunda ex corio, quorum ope aqua extollitur in pompa.

D. rotula per quam dicta rotunda in altum elevantur.
E. pecten movens rotulam D. et B.
F. est rota à rota inferiori G. circumducta, cujus dentibus pecten E. circulariter agit.
H. pecten movens rotam G.

INSTRUMENTI HUJUS USUS.

Numeratur hoc instrumentum inter rotas primæ differentiæ, quod valdè est necessarium in multis usibus, quia minimo labore magnam aquæ quantitatem sursum propter rotarum multitudinem ferre non est dubium.

Longitudo autem haustri A. est 35. pedum, ejus verò latitudo pedis 1. cum $\frac{1}{2}$ secundum proportionem, cujus concavitates rotundæ exactè fieri debent, ut non perdant aliquid aquæ ab iis attractæ in suis ascensionibus; Pompæ igitur concavitas erit bene rotunda.

Rota magna aquaria habebit pedes 24. in altitudine: Illa verò G. pedes 20.

Italus ille, sua contemplatione deceptus putabat se tantum aquæ per pompam elevaturum, ut rotam aquariam perpetuò movere cogeret, quia majorem vim requiri dicebat in fine hujus instrumenti, qùam in principio, sed, quia malè capiebat ponderum proportiones, igitur in sua praxi erat deceptus.*

The second Latin authority we have to offer is BETTINO, as follows:—

Motum aquæ per machinas perpetuum molitionibus longe facillimis attentare.

Motus ille graunium circa terræ centrum perpetuus indicatus in 7 & 8 propositionibus, etiam si fieri posset, esset tamen inutilis humanæ, ac ciuilis vitæ necessitatibus. In hac decima propositione motum aquæ perpetuum attentamus per machinas; qui motus si fieret, maximo esset usui, et quæstusa compendia ex eo in vitam humanam redundarent. Ut igitur aliquid circa famosissiman hanc materiam nos etiam ex nostro

* Tractatus Secundus De Naturæ Simia seu Technica macrocosmi historia in partes undecim divisa. Roberto Fludd alias de Fluctibus Armigero et in Medicina Doctore Oxoniensi. In Nobili Oppenheimio. Folio. 1618. Pp. 456 and 462.

sensu prodamus, aio (quod attinet ad theoricam quandam constructionem ex ingenii geometrici, ac scientifici inventione, prodeuntè) plures machinas aquaticas construi posse, aut ab antiquis ingeniosissimè constructas facillimo negotio ita posse accomodari, ut, fortasse, nisi quid obstet exparte materiæ (à quæ mathematica inventio abstrahit, nec culpam subit physicæ imperfectionis) machinæ illæ semper eâdem aquæ quantitate in orbem ascendente, ac descendente, perpetuo quodam motu agitentur.

Exemplum exhibiamus in mirissima illa machina cochleæ Archimedeæ per lineas spirales aquā haurientis, et (ut in sequenti propositione demonstrabimus) deuectione pondus impositum euehentis. Moveatur rota A B C, et cochleæ G D pes G è subiecto lacu G E aquam attollat per spiralem, ac volutam circa cilindrum G D. Cum aqua peruenerit ad D, atque effundetur, excipiatur canali, seu tubo D F, qui tubus versus rotam A B C deuexus deferat aquam, atq; effundat in rotam cuius aquæ decidentis vis supplebit vices potentiæ moventis rotam: ac dum rota ab aqua movetur movetur et cochlea, et cochlea aquam haurit, atq; attollit, aqua sublata revertitur, ac refunditur in rotam, é rota excipitur in lacum. Atq; hoc aquæ circulo machina cochleæ, quæ impetum accepit à motrice potentia an non iam per se solo aquæ circumitu ciebitur, motuq; rotabitur perpetuo dum aqua é lacu non defecerit?

Pariarte, atq; invēto machina Ctesibii, cuius fabricam, et simulacrū habes apud Vitruuium, et aliæ aliquæ antiquorum, si fiat ut aquæ quam attolunt, refundatur in rotam, qua machinam moveat, an non poterunt motus perpetui exempla præbere? Sed nos exemplum nostrum exhibuimus in cochlea tum ob alia, tum præcipue ob duo, quæ mox apponam, quibus singulariter in hac machina facilior fit constructio, et usus ad motum perpetuum, quám in alia ulla; prætereaq; reiici vidētur oppositiones præcipuæ, quæ obstare possunt molientibus inventa pro motu aquæ per machinas perpetuo.

Primò enim si fingas, atq; opponas requiri maiorem uim motricem in rota, quám sit aquæ uis, ac quantitas in rotam decidentis, ut cochlea pondus aquæ possit attollere, etiam si augeatur vis aquæ dum sublata in machinam deinde in natæ gravitatis nisu, ac pōdere maiori præcipi dantur revoluta in rotam machinæ motricem. Respondeo primò singulare esse in cochlea ut minor vis ad eius motionem proportione requira-

tur, quàm, in alia ulla machina, duas præcipuè ob causas. Prima est quia euectio illa per spiralem circa cylindrum, vel conum, est aliqua, & minus violenta, quàm sublatio aquæ perpendiculariter ascendentis, vel per vim ejectæ, ut in Ctesibiana machina, et in aliis quibusdam fit. Secunda causa facilitatis ad motum in cochleà est à modo peculiari, atq; admirando euectionis ponderum per spiralem, dùm cochlea obliqua circumuoluitur; ea enim euectio ita fit, ut pondera ipsa suam euectionem inuent. Nam fit quidam motus mixtus ex continenti quodam decensu simul, atq; ascensu gravium, quæ gravia dum motu proprio descensum affectant, decurrunt sponte per spiralem, atq; ipsa spiralis ex circumuolutione cochleæ pondera decurrentia sensim, atq; oblique, ac quasi furtiuè paullatim attollit. plura inferius in sequenti proposit. 11 et in schol. 1 ad eam propositionem dicemus circa miriss hunc motum spiralem, &c.

Minor vis requiritur ad motum cochlea, qũàm aliarum machinarum.

Respondeo 2, quod ad aquæ quantitatem, ac vim, cóchlea habet etiam hoc eximiũ, ac peculiare, ut in ipsa machina (hoc est circa cylindrum, vel conum) possint multiplicari volutæ, siue tubi spirales ita, ut non unica tantum sit spiralis (quod hactenus in usu fuit circa cylindricas cochleas) sed ternæ, quaternæ, ac plures spirales circumpositæ maiorem aquæ copiam pro numero spiralium hauriant, et attollant. Qua de re inferius in schol. 2 proposit. sequentis undecimæ. Nunc tantúm ad rem indico quemadmodum aquæ copia possit augeri, ut aquare, ac superare possit uim potentiæ rotam A B C moventis.

Notandum est universé circa hunc aquæ circulum per aptas machinas ad motũ perpetuum, canales, ac tubos machinarum, per quos aqua influet sic aptandos, et cum omni cautione muniendos, ut nihil aquę inter fluẽtis, aut defluentis possit furtim effluere, atq; effundi. Nam exea aquæ effusione imminueretur non solum quantitas, sed et uis aquæ necessaria ad machinam movendam, et ad motum perpetuandum.

Nota cautionem.

Si tamen, ut in nostra figurà, aqua, post defluxum in rotam diffluat in lacum, nihil aquæ peribit, &c. etiam si apertè decidant. Eadem enim aquæ quantitas semper refunditur in lacum.

Vide ad motum perpetuum adhuc maiora adiumenta propos. 14 inferius in hoc progym. [Apiar. IV., progym. I., prop. X.]

Horaria dioptrica, & catoptrica. Machinæ perpetuo motu diu, noctuq; solis cursum sequentes, ac per horas dimentientes.

1. Pertinent ad paradoxa gnomonica horologia dioptrica, velut scaphia, in quibus aquà infusis umbra gnomonis per aquam refracta horas indicat. Reuise nos initio Apiarii nostri astronomici, ubi modum apposuimus metendi organicè quantitatem anguli refractorii per scaphia. Nihil nos híc de iis dioptricis horariis, quia nihil habent in nouitate utilitatis, immo solùm addunt plures difficultates fabricæ, ac usui horariorum in scaphiis usitatorum.

Horaria dioptrica, in quibus horæ per refractionem, &c.

2. Sunt et horaria catoptrica, in quibus et horariæ lineæ ínuersæ, et specillum loco verticis gnomonici reflectit radium solis ad horas indicandas. De quibus vide opusculum doctissimum erudissimi P. Athanasii Kircheri è nostra Societate, qui unus è tribus fuit césoribus, et adprobatoribus Romæ meorum Apiariorum. Novitas in iis catoptricis horariis ingeniosa, et in eo præcipue utilis est quòd horas indicet intracubicula, et conclavia in umbra, ne oculorum aciem præstringat solis fulgor, &c. Nos in sequenti capite aliquem usum catoptricum nō catoptricorum horariorum dabimus, quem apud alios non vidimus.

Horaria catoptrica, in quibus horæ per reflexionem.

3. Machinas horarias aliqui machinati sūt, in quibus vel rotularum supra aquam libratarum mobilis index, vel globulus in aqua mobilis diu, noctuq; perpetua, lentissimaq; rotatione motum solis sequuntur. Hæ machinæ non tam ad mathematicum quám ad physicum philosophum pertinent, et extra nostrum institutum sunt, qui mathematica inventa geometricis demonstrationibus confirmata profitemur; ob admirandam tamen novitatem digna sunt ea horaria, quæ inter nostra paradoxa reponantur accipe verba, et iconem unius è prædictis machinæ, ut iacent apud P. Sylvestrum Petra sanctam nostra societatis, in expolitissimo opere de symbolis heroicis lib. 4 in fine capitis 5. Scio magnetis lapidis effecta prorsus admiranda esse, atq; ex illius virtute prodire semper aliquid novi. Sic Leodu nuper in Collegio Anglorū nostræ Societatis P. Frāciscus Linus Magister matheseos excogitavit felicissime orbem, qui intra phialam (velut B C A) in circunfusæ aquæ centro (sicut in circunfuso aëre tellus) hæret secreto suæ molis libramento (ut ad D). Sed conuersionem

Mira horaria machina cū motu perpetuo.

cæli tamen ab ortu in occasum arcanà vi, et veluti quodam amore consectatur, spatioq; vigintiquatuor horarum omnino circumagitur.

Pisciculus intereà indicis loco est (ceu in G) et quasi nandi peritus, ac libratus pondere suo prætereuntes horas veluti admirās designat rostro, easq; oculis de fixis intuetur. Motà phialà, si aquæ impetus detur, mox iter sua sponte orbis releget; penitusq; ratio temporis constabit, postquam tranquillitas redierit.

Indicem quoq; in phialà constituas, et indicabit perinde horas. Sed et solem finge in eodem orbe, verum solem in ortu, meridie, occasu sequetur, atq; adeo è sede sua excussas requiret illicò, et repetet stationem syderi consentaneam. Tantum plus nimis adproper abit, quia nescit amor tarditatem: nihilominus dum aliquoties transiliet, resilietq; demum ob inebit locum, ex cuo citra errorem solis comes denuò ibit.

Vitreus orbis A C B sustinetur, ut vides, lector, ab aquà peluis C E F B.

Egent tamen etiam hæ machinæ, quemadmodum et authomata horaria ex ponderibus, vel ex chalybe contorto, subinde aliqua restauratione, quia deniq; nullum à mortalibus inventum est immortale, ac verà perpetuum.* [Apiar. IX., progym. V., prop. XI.]

* Apiaria Universæ Philosophiæ Mathematicæ in quibus Paradoxa. By Mario Bettino Bononiensi e Soc. Jesu. Bononiæ, 1645. Fol.o.

CHAPTER II.

INVENTIONS OF THE MARQUIS OF WORCESTER, AND COUNCILLOR ORFFIREUS.

EDWARD SOMERSET, sixth Earl and second Marquis of Worcester, born at Ragland, near Monmouth, author of the "Century of Inventions," was much distinguished in his youth by King Charles I., during several visits he made to Ragland Castle, and who subsequently appointed him Lord-Lieutenant of North Wales, addressing him as Earl of Glamorgan, until he succeeded to his heritable honours. Walpole has been justly censured for describing him as "a fanatic projector," and his "Century" as "an amazing piece of folly." He died in retirement near London, 1667, in reduced circumstances.

The following is the fifty-sixth article transcribed from the manuscript of the "Century of Inventions," dated 1659, and indexed therein as "An advantageous change of centers:"—

56. To prouide and make that all y^e^ weights of y^e^ defcending syde of a wheele shal be perpetually further from y^e^ center, then thofe of y^e^ mounting syde, and yett equall in number and heft of y^e^ one syde as y^e^ other. A most incredible thing if not seene, butt tryed before y^e^ late King of happy and glorious memorye in y^e^ Tower by my directions, two Extraordnary Embaffadors accompanying his Ma^tie^ and y^e^ D. of Richmond, D. Hamilton, and most part of y^e^ Court attending him. The wheele was 14 foote ouer, and 40 weights of 50 p^d^ apiece; S^r^ Wm. Belford, then Lieu^t^ of y^e^ Tower, and yet liuing can justify it with seuerall others; They all saw that noe sooner these great weights passed y^e^ Diameter Line of y^e^ vpper syde but they hung a foote further from y^e^ center,

nor no sooner passed the Diameter line of the lower syde, butt they hung a foote nearer; bee pleased to judge y^e^ consequence.*

Note on above, from an edition of the "Century of Inventions," edited by Charles F. Partington. 1825:—

The celebrated problem of a self-impelling power, though denied by Huygens and De la Hire, who have attempted to demonstrate its fallacy, has yet been supported by some of the most celebrated among the ancient as well as modern philosophers. Innumerable have been the machines to which the idea of the perpetual motion has given birth, but the most celebrated among the moderns is the Orffyrean Wheel. This machine, according to the description given of it by M. Grævesande, in his "Œuvres Philosophiques," consisted of a large circular wheel or drum, twelve feet in diameter, and fourteen inches in depth. It was composed of a number of thin deals, the spaces between which were covered with wax cloth, in order to conceal the inner parts of it. On giving the wheel, which rested on the two extremities of an iron axis, a slight impulse in either direction, its motion was gradually accelerated; so that, after two or three revolutions, it is said to have acquired so great a velocity as to make twenty-five or more turns in a minute: and it appears to have preserved this rapid motion for the space of two months, during which time the Landgrave of Hesse, in whose chamber it was placed to prevent a possibility of collusion, kept his own seal on the outer door. At the end of that time it was stopped to prevent the wear of the materials. Grævesande, who had been an eye-witness to the performance of this machine, examined all the external parts of it, and was convinced that there could not be any communication between it and the adjacent rooms. Orffyreus, however, having been informed of the ill-timed curiosity of the professor, and incensed at the refusal of a premium of twenty thousand pounds, which he had made a *sine quâ non* for disclosing the mechanism of its construction, broke the whole apparatus into atoms, and his life was soon after sacrificed to chagrin at his disappointment. The analogy between the Marquis's description and the Orffyrean Wheel is sufficiently evident; and the experiment having been made in the Tower more

* See Harleian MS., No. 2,428, in the British Museum.

than fifty years prior to the attempt of the German mechanic, it is more than probable that the idea was derived from the noble author's work.

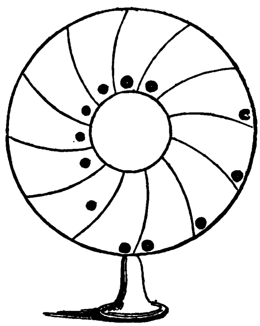
Mr. Partington, in his "Manual of Natural Philosophy," writes as follows on Perpetual Motion:—

Having taken a brief review of the simple machines which are usually considered under the general character of mechanical powers, it may now be advisable to examine how far a combination of these powers can tend towards producing a perpetual motion. There are few subjects, indeed, that have more engaged the attention of the mechanical world in every age, than the solution of this apparently difficult problem; and their repeated failure has been no bar to renewed attempts.

It may, indeed, be demonstrated that a perpetual motion is impossible, at least by the ordinary laws of nature; for to be possible, it is necessary that the effect should become alternately the cause, and the cause the effect. It would be necessary, for example, that a weight raised to a certain height by another weight, should in its turn raise the second weight to the height from which it descended. Now this we know to be impossible.

Amongst the various attempts at a perpetual motion, that of a circular wheel, described by the Marquis of Worcester and Orffyreus, offered at first view the greatest chance of success.

The Marquis of Worcester's account of a perpetual motion occurs in the fifty-sixth article of his "Century of Inventions."*



In this cylindrical wheel, or drum, are formed channels, containing balls of lead, which alternately approach and recede from the centre; and it would seem, upon the principle of the lever, that as the weights are always further from the centre on one side than on the other, a continuous rotatory motion must be produced.

But, notwithstanding the specious appearance of this reason-

* See preceding article.

ing, experience has proved that the machine will not turn perpetually; and it will be seen, on inspection, that, though some of the weights are more distant from the centre than others, yet there is always a proportionably smaller number of them on the side at which they have the greatest power, so that these two circumstances precisely counterbalance each other.*

The Marquis's wheel will be found often referred to in notices occurring in succeeding pages; indeed, the invention and its ingenious author are sufficiently remarkable, no one having been able to reproduce a wheel possessing the precise properties he mentions, or satisfactorily contradict the statement he has made.

The only other invention we have here to consider is the celebrated one constructed by Jean Ernest Elie-Bessler ORFFYRE or ORPHYRREUS, who is usually named Orffyreus when noticed in English and German † works on mechanics. He was born in 1680, near Zittan, in the department of Alsace, France, and early studied theology and medicine, but his erratic genius was only to be satisfied by engaging himself in the pursuit of a variety of the mechanical arts and painting. He asserts that it was during his search for whatever might prove curious and valuable that he discovered Perpetual Motion, and between the years 1712 and 1719, made two machines on his system; one he desired to exhibit publicly, but broke it up rather than submit to the payment of the licence or tax required by the Government of Cassel; the other he destroyed after its having been unfavourably reported on by M.'S Græevesande. He published, in German and Latin, a book, or pamphlet, entitled "Le Mouvement Perpétuel Triomphant," quarto, dated Cassel, 1719.‡

* A Manual of Natural and Experimental Philosophy. By Charles F. Partington. 8vo.

† Leupold styles him Herr Rath Orffyreus, he being one of the Councillors to the Prince of Hesse Cassel. [See Appendix A.]

‡ See Dezobry and Bachelet's Dictionnaire Générale de Biographie, &c. Paris, 1857. Royal 8vo.

Other accounts differ, as will presently appear, respecting the breaking of the second machine; and, on insufficient authority, Mr. Partington styles him a "German mechanic." Dr. William Kenrick, among his miscellaneous works, wrote "An Account of the Automaton, or Perpetual Motion of Orffyreus, with additional remarks," in editions dated 1770 and 1771. Orffyreus died November, 1745.

We shall now proceed to give notices and attempted refutations of his and supposed like inventions.

The "Annual Register" for 1763 gives the following interesting correspondence about Orffyreus and his wheel:—

On the possibility, and use towards finding the longitude, of a Perpetual Motion.

Sir,—The "Utrecht Gazette" some time since informed us, "that a mechanic* of East-Friesland hath invented a machine, which, being once put in motion, keeps perpetually going till such time as the materials of which it is composed are fallen to decay, or the structure of the machine itself is altered." To this account some blundering news-writer, I suppose, has added the following reflection: "If this be true, we have here a discovery of the longitude under all the variations of climes, seasons, weather, &c., an invention which the great Leibnitz and Bernouilli thought as impossible as the squaring of the circle, or the discovery of an universal panacea." Now, Sir, whether the information contained in the above article be true or false, or whether such a discovery be practicable or only chimerical, certain it is we should be no otherwise benefited by, in regard to the longitude, than as it might be productive of a time-keeper, that would not want winding up. It is, however, an equable as well as a constant motion, that is wanted to determine the longitude; so that every such machine must be regulated by a pendulum, and would then, as well as in other respects, be subject to the variations of climes and seasons. Again, the reflector is mistaken in saying that both Leibnitz and Bernouilli thought this discovery impossible. The former, indeed, constantly affirms its impossibility; and yet in his disputes with Papin, published in the "Acta Lipsiensia," he declares, that if the force of a body in motion be in a direct

proportion to its velocity (as it is now universally known to be) a perpetual motion must be possible. And with regard to Bernouilli, you may find in the first volume of his works, page 41 *& seq.*, that he not only declares it to be possible, but also that he had actually conceived a method whereby it might be rendered practicable. De la Hire and other eminent mathematicians pretend, indeed, to have demonstrated the impossibility of such a discovery. But it is certain that others have not thought those demonstrations applicable to all possible machines. Among these may be mentioned the late Professor 'S Gravesande of Leyden, undoubtedly one of the first mathematicians, and as well versed in geometry and mechanics as any man of his time. Yet this gentleman wrote a treatise professedly to prove the possibility in question; nay, it appears that he went so far as to think it had been actually discovered in the machine of Orfyreus, that made such a noise at Hesse Cassel about forty years ago; and which he examined at the desire of the landgrave, with the utmost care and attention. Indeed, I cannot help thinking that the dispute subsisting between the philosophers concerning the momenta of moving bodies, which was at that time at its highest warmth, prevented that machine from being so much attended to as it deserved. In this opinion also I am strongly confirmed by a letter, written by that professor to Sir Isaac Newton on the subject of that machine; which letter, as I know not where it is to be found in the English language, I have translated from the French,* for the information or entertainment of your readers:—

A Letter from Professor 'S Gravesande to Sir Isaac Newton, concerning Orfyreus's Wheel.

SIR,—Doctor Desaguliers has doubtless shown you the letter that Baron Fischer wrote to him some time ago, about the wheel of Orfyreus; which the inventor affirms to be a perpetual motion. The landgrave, who is a lover of the sciences and fine arts, and neglects no opportunity to encourage the several discoveries and improvements that are presented him, was desirous of having this machine made known to the world, for the sake of public utility. To this end he engaged me to examine it; wishing that, if it should be

* Printed in the "Mercure Historique et Politique," September, 1721.

found to answer the pretensions of the inventor, it might be made known to persons of greater abilities, who might deduce from it those services which are naturally to be expected from so singular an invention. You will not be displeased, I presume, with a circumstantial account of this examination; I transmit you therefore a detail of the most particular circumstances observable on an exterior view of a machine, concerning which the sentiments of most people are greatly divided, while almost all the mathematicians are against it. The majority maintain the impossibility of a perpetual motion, and hence it is that so little attention hath been paid to Orfyreus and his invention.

For my part, however, though I confess my abilities inferior to those of many who have given their demonstrations of this impossibility; yet I will communicate to you the real sentiments with which I entered on the examination of this machine. It is now more than seven years since I conceived I discovered the paralogism of those demonstrations, in that, though true in themselves, they were not applicable to all possible machines; and have ever since remained perfectly persuaded, it might be demonstrated that a perpetual motion involved no contradiction; it appearing to me that Leibnitz was wrong in laying down the impossibility of the perpetual motion as an axiom. Notwithstanding this persuasion, however, I was far from believing Orfyreus capable of making such a discovery, looking upon it as an invention not to be made (if ever) till after many other previous discoveries. But since I have examined the machine, it is impossible for me to express my surprise.

The inventor has a turn for mechanics, but is far from being a profound mathematician, and yet his machine hath something in it prodigiously astonishing, even tho' it should be an imposition. The following is a description of the external parts of the machine, the inside of which the inventor will not permit to be seen, lest any one should rob him of his secret. It is an hollow wheel, or kind of drum, about fourteen inches thick, and twelve feet diameter; being very light, as it consists of several cross pieces of wood framed together; the whole of which is covered over with canvas, to prevent the inside from being seen. Through the centre of this wheel or drum runs an axis of about six inches diameter, terminated at both ends by iron axes of about three-

quarters of an inch diameter upon which the machine turns. I have examined these axes, and am firmly persuaded that nothing from without the wheel in the least contributes to its motion. When I turned it but gently, it always stood still as soon as I took away my hand; but when I gave it any tolerable degree of velocity, I was always obliged to stop it again by force; for when I let it go, it acquired in two or three turns its greatest velocity, after which it revolved for twenty-five or twenty-six times in a minute. This motion it preserved some time ago for two months, in an apartment of the castle: the door and windows of which were locked and sealed, so that there was no possibility of fraud. At the expiration of that term indeed his serene highness ordered the apartment to be opened, and the machine to be stopped, lest, as it was only a model, the parts might suffer by so much agitation. The landgrave being himself present on my examination of this machine, I took the liberty to ask him, as he had seen the inside of it, whether, after being in motion for a certain time, no alteration was made in the component parts; or whether none of those parts might be suspected of concealing some fraud: on which his serene highness assured me to the contrary, and that the machine was very simple.

You see, Sir, I have not had any absolute demonstration, that the principle of motion which is certainly within the wheel, is really a principle of perpetual motion; but at the same time it cannot be denied me that I have received very good reasons to think so, which is a strong presumption in favour of the inventor. The landgrave hath made Orfyreus a very handsome present, to be let into the secret of the machine, under an engagement nevertheless not to discover, or to make any use of it, before the inventor may procure a sufficient reward for making his discovery public.

I am very sensible, Sir, that it is in England only the arts and sciences are so generally cultivated as to afford any prospect of the inventor's acquiring a reward adequate to this discovery. He requires nothing more than the assurance of having it paid him in case his machine is found to be really a perpetual motion; and as he desires nothing more than this assurance till the construction of the machine be displayed and fairly examined, it cannot be expected he should submit to such examination before such assurance be given him. Now, Sir, as it would conduce to public utility, as well as to

the advancement of science, to discover the reality or the fraud of this invention, I conceive the relation of the above circumstances could not fail of being acceptable. I am, &c.

Nothing can be more in favour of Orfyreus than this testimony of Mr. 'S Gravesande; so that, on a supposition that the Gazette-writer of Utrecht hath not imposed upon us, the East-Frieslander hath probably done no more than Orfyreus did before him; the world having been so long deprived of the advantages that must necessarily attend the publication of such a discovery, from the effects of a mistaken prejudice, equally destructive to the improvement of the arts and sciences, as to the happiness of mankind.*

The following remarks of Dr. Desaguliers on Perpetual Motion, in the thirty-first volume of the "Philosophical Transactions," are repeated in the first volume of his "Course of Experimental Philosophy," and are thus introduced:—

14. [70.—Pretenders to perpetual motions, and those who promise greater effects by machinery than is conformable to the reciprocal proportion between the intensities of the powers and weights, and their velocities.] About the year 1720 and 1721, the late John Rowley, mathematical instrument maker, talk'd so much of the wheel which he had seen at Hesse-Cassel (which he believed to be a perpetual motion, as well as a great many persons in that country) that besides the common herd of Perpetual Motion men, which every age affords, some very ingenious men made an attempt that way, and were countenanc'd in it by some great mathematicians, who, when the scheme was laid before them, declar'd they knew no reason why it should not do. But as I always declar'd against all projects tending that way, I was desir'd at that time to publish my reasons why the thing seem'd impossible or impracticable; which I did in the "Philosophical Transactions" (No. 369) in such a manner as might dissuade people at first from any such attempts, in which so much time and money have been lost. I have here printed the whole account again.†

* The Annual Register, for the year 1763, vol. 6, pp. 126-128.

† A Course of Experimental Philosophy. By J. T. Desaguliers, LL D., F.R.S. 2 vols. 4to. Second Edition, 1745. Vol. 1, p. 183.

[The annexed paper, from the "Philosophical Transactions," is the one above-named:—]

Remarks on some Attempts made towards a Perpetual Motion; by the Reverend Dr. Desaguliers, F.R.S.

The wheel at Hesse-Cassel, made by Monsieur Orfireus, and by him called a perpetual motion, has of late been so much talk'd of, on account of its wonderful phænomena, that a great many people have believed it to be actually a self-moving engine; and accordingly have attempted to imitate it as such. Now, as a great deal of time and money is spent in those endeavours, I was willing (for the sake of those that try experiments with that view) to shew that the principle which most of them go upon is false, and can by no means produce a perpetual motion.

They take it for granted, that if a weight descending in a wheel, at a determined distance from the centre, does in its ascent approach nearer to it; such a weight in its descent will always preponderate, and cause a weight equal to it to rise, provided it comes nearer the centre in its rise; and accordingly as itself rises, will be overbalanced by another weight equal to it; and therefore they endeavour by various contrivances to produce that effect, as if the consequence of it would be a perpetual motion.

But I shall shew that they mistake one particular case of a general theorem, or rather a corollory of it, for the theorem itself. The theorem is as follows:—

THEOR.—If one weight in its descent does by means of any contrivance cause another weight to ascend with a less momentum or quantity of motion than itself, it will preponderate and raise the other weight.

COR. 1.—Therefore if the weights be equal, the descending weight must have more velocity than the ascending weight, because the momentum is made up of the weight multiplied into the quantity of matter.

COR. 2.—Therefore if a leaver or balance have equal weights fasten'd or hanging at its ends, and the brachia be ever so little unequal, that weight will preponderate which is farthest from the centre.

SCHOLIUM.—This second corollary causes the mistake; because those, who think the velocity of the weight is the line it describes, expect that that weight shall be overpois'd,

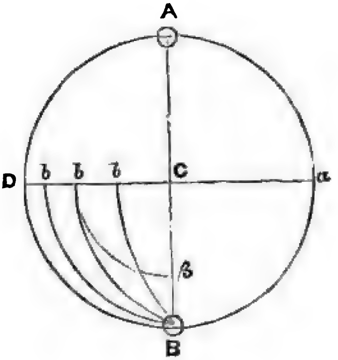
which describes the shortest line, and therefore contrive machines to cause the ascending weight to describe a shorter line than the descending weight. As for example, in the circle A D B *a* (Fig. 3) the weights A and B being supposed equal, they imagine, that if (by any contrivance whatever) whilst the weight A describes the arc A *a*, the weight B is carried in any arc, as B *b*, so as to come nearer the centre in its rising, than if it went up the arc B D; the said weight shall be overpois'd, and consequently, by a number of such weights, a perpetual motion will be produced.

This is attempted by several contrivances, which all depend upon this false principle; but I shall only mention one, which is represented by Fig. 4, where a wheel having two parallel circumferences, has the space between them divided into cells, which being curv'd, will (when the wheel goes round) cause weights plac'd loose in the said cells, to descend on the side A, at the outer circumference of the wheel, and on the side D to ascend in the line B *b b b*, which comes nearer the centre, and touches the inner circumference of the wheel. In a machine of this kind, the weights will indeed move in such a manner, if the wheel be turn'd round, but will never be the cause of the wheel's going round. Such a machine is mentioned by the Marquis of Worcester, in his "Century of Inventions," in the following words, No. 56:—

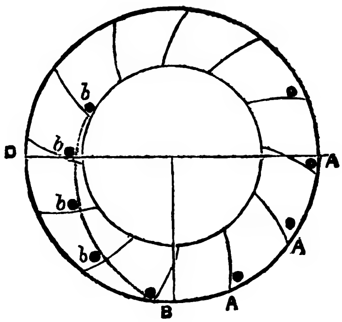
"To provide and make that all the weights of the descending side of a wheel, shall be perpetually farther from the centre, than those of the mounting side, and yet equal in number and heft to the one side as the other. A most incredible thing, if not seen; but tried before the late King (of blessed memory) in the Tower by my directions, two extraordinary ambassadors accompanying his Majesty, and the Duke of Richmond, and Duke of Hamilton, with most of the Court attending him. The wheel was fourteen foot over, and had fourty weights of fifty pounds a piece. Sir William Balfore, then Lieutenant of the Tower, can justify it, with several others. They all saw, that no sooner these great weights passed the diameter line of the lower side, but they hung a foot farther from the centre; nor no sooner passed the diameter line of the upper side, but they hung a foot nearer. Be pleased to judge of the consequence."

Now the consequence of this, and such like machines, is nothing less than a perpetual motion; and the fallacy is this:

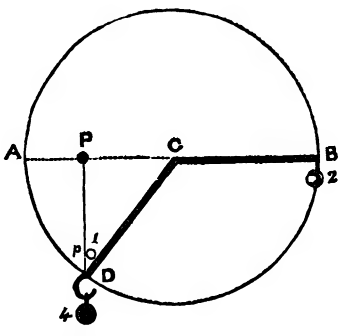
(*Fig. 3.*)



(*Fig. 4.*)



(*Fig. 5.*)



The velocity of any weight is not the line, which it describes in general, but the height that it rises up to, or falls from, with respect to its distance from the centre of the earth. So that when the weight (Fig. 3) describes the arc A *a*, its velocity is the line A C, which shews the perpendicular descent (or measures how much it is come nearer to the centre of the earth), and likewise the line B C denotes the velocity of the weight B, or the height that it rises to, when it ascends in any of the arcs B *b*, instead of the arc B D: so that in this case whether the weight B, in its ascent be brought nearer the centre or not, it loses no velocity, which it ought to do, in order to be rais'd up by the weight A. Nay, the weight in rising nearer the centre of a wheel, may not only not lose of its velocity, but be made to gain velocity, in proportion to the velocity of its counterpoising weights, that descend in the circumference of the opposite side of the wheel; for if we consider two radii of the wheel, one of which is horizontal, and the other (fasten'd to and moving with it) inclin'd under the horizon in an angle of 60 degr. (Fig. 5) and by the descent of the end B of the radius B C, the radius C D by its motion causes the weight at D, to rise up the line *p* P, which is in a plane that stops the said weight from rising in the curve D A, that weight will gain velocity, and in the beginning of its rise, it will have twice the velocity of the weight at B; and consequently, instead of being rais'd, will overpoise, if it be equal to the last mention'd weight. And this velocity will be so much the greater, in proportion as the angle A C D is greater, or as the plane P *p* (along which the weight D must rise) is nearer to the centre. Indeed, if the weight at B (Fig. 3) could by any means be lifted up to β, and move in the arc β *b*, the end would be answer'd; because then the velocity would be diminished, and become β C.

Experiment (Fig. 5).—Take the leaver B C D, whose brachia are equal in length, bent in an angle of 120 degr. at C, and moveable about that point as its centre: In this case, a weight of two pounds hanging at the end B of the horizontal part of the leaver, will keep in æquilibrio a weight of four pounds hanging at the end D. But if a weight of one pound be laid upon the end D of the leaver, so that in the motion of D along the arc *p* A, this weight is made to rise up against the plane P *p* (which divides in half the line A C equal to

C B) the said weight will keep in æquilibrio two pounds at B, as having twice the velocity of it, when the leaver begins to move. This will be evident, if you let the weight 4 hang at D, whilst the weight 1 lies above it: for if then you move the leaver, the weight 1 will rise four times as fast as the weight 4.*

Notice of the Wheel of Orffyreus, in the "Gentleman's Magazine," in a letter on—

Perpetual Motion said to be discovered.

MR. URBAN,—Being an admirer of improvements in mechanics, and desirous of seeing the perpetual motion discovered, I was much pleased on reading, some time ago, an account of the automaton constructed by Orffyreus, in two letters, one from Professor s'Gravesande to Sir Isaac Newton, the other from Baron Fischer to Dr. Desaguliers, with the testimonial of the Landgrave of Hesse-Cassel (who had seen the inside of it) in favour of its construction. To which are added some remarks by William Kenrick, the writer of the pamphlet, who takes that opportunity to propose a subscription for a similar machine, which he says he has contrived, and denominated a Rotator.

It is much to be lamented that the learned did not examine more strictly into the merit of Orffyreus's wheel; but, on the contrary, being prepossessed with a notion of the impracticability of the perpetual motion, suffered it to be neglected, and at last destroyed by the hands of a disappointed mechanic, who, with unwearied application and steady perseverance, had brought it to perfection. I wish we may not again let slip an opportunity of becoming acquainted with an invention, which, when made public, will reflect honour on the inventor, and be of the utmost utility to the world. Such, I would hope, is the rotator mentioned by W. Kenrick; for, unless his discovery were real, I cannot think that he would have taken the liberty to express himself as he does in p. 26, &c. "The inventor flatters himself that, if the contents of the foregoing pages are seriously attended to, and it be farther considered, that not a penny of the proposed premium is required, till the subscribers are fully satisfied of the reality and utility of the

* The Philosophical Transactions, vol. 31, for the years 1720, 1721. 4to. No. 369, Sep., Oct., Nov., Dec., 1721, page 237.

invention, his proposal will not be treated with so mortifying a neglect as that of Orffyreus." Again he says, "If it does not supply the place of a first mover, at the expense only of the construction and repair of a simple wheel, subject to very little friction, and that in all such engines and machines, even from the slightest piece of clockwork to the waterworks of Marli or London-bridge, he expects nothing for his discovery, but to stand exposed to the contempt that will be justly thrown on him, for having so miserably mispent his time, and frivolously engaged the attention of the public."

Now, I think that W. Kenrick's proposals are very fair; and should be glad to be informed, whether any attenticn has been paid to them, and whether Sir Isaac Newton took any notice of the letter addressed to him by Professor s'Gravesande. I shall consider it as a favour if any correspondent will oblige me with an answer to these particulars.

A Constant Reader.*

Dr. Hutton, in his notice "Of the Perpetual Motion," incidentally condemns the wheel of Orffyreus, observing :—

The perpetual motion has been the quicksand of mechanicians, as the quadrature of the circle, the trisection of an angle, &c., have been that of geometricians: and as those who pretend to have discovered the solution of the latter problems are in general persons scarcely acquainted with the principles of geometry, those who search for, or imagine they have found, the perpetual motion, are always men to whom the most certain and invariable truths of mechanics are unknown.

It may be demonstrated, indeed, to all those capable of reasoning in a sound manner on those sciences, that a perpetual motion is impossible: for, to be possible, it is necessary that the effect should become alternately the cause, and the cause the effect. It would be necessary, for example, that a weight raised to a certain height by another weight, should in its turn raise the second weight to the height from which it descended. But, according to the laws of motion, all that a descending weight could do, in the most perfect machine which the mind can conceive, is to raise another in the same time to a height reciprocally proportional to its mass. But

* The Gentleman's Magazine. Vol. 42. 1772. P. 172.

it is impossible to construct a machine in which there shall be neither friction nor the resistance of some medium to be overcome; consequently at each alternation of ascent and descent, some quantity of motion, however small, will always be lost: each time, therefore, the weight to be raised will ascend to a less height; and the motion will gradually slacken, and at length cease entirely.

A moving principle has been sought for, but without success, in the magnet, in the gravity of the atmosphere, and in the elasticity of bodies. If a magnet be disposed in such a manner as to facilitate the ascension of a weight, it will afterwards oppose its descent. Springs, after being unbent, require to be bent by a new force equal to that which they exercised; and the gravity of the atmosphere, after forcing one side of the machine to the lowest point, must be itself raised again, like any other weight, in order to continue its action.

We shall, however, give an account of various attempts to obtain a perpetual motion, because they may serve to show how much some persons have suffered themselves to be deceived on this subject.

Fig. 52, pl. 12.)

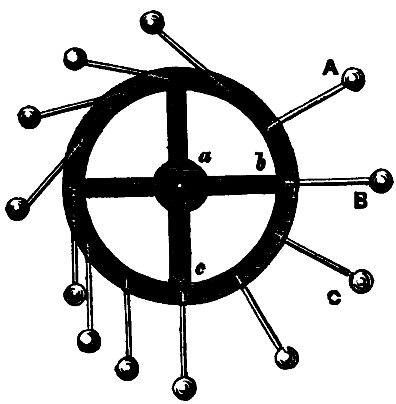
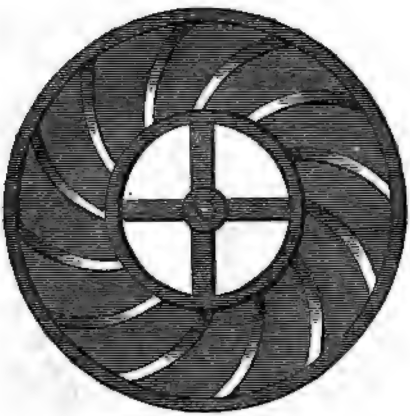


Fig. 52, plate 12, represents a large wheel, the circumference of which is furnished, at equal distances, with levers, each bearing at its extremity a weight, and moveable on a

hinge, so that in one direction they can rest upon the circumference, while on the opposite side, being carried away by the weight at the extremity, they are obliged to arrange themselves in the direction of the radius continued. This being supposed, it is evident that when the wheel turns in the direction *a b c*, the weights A B and C will recede from the centre; consequently, as they act with more force, they will carry the wheel towards that side; and as a new lever will be thrown out, in proportion as the wheel revolves, it thence follows, say they, that the wheel will continue to move in the same direction. But, notwithstanding the specious appearance of this reasoning, experience has proved that the machine will not go; and it may indeed be demonstrated that there is a certain position in which the centre of gravity of all these weights is in the vertical plane passing through the point of suspension, and that therefore it must stop.

The case is the same with the following machine, which it would appear ought to move also incessantly. In a cylindric drum, in perfect equilibrium on its axis, are formed channels as seen in Fig. 53, which contain balls of lead, or a certain

(*Fig.* 53.)

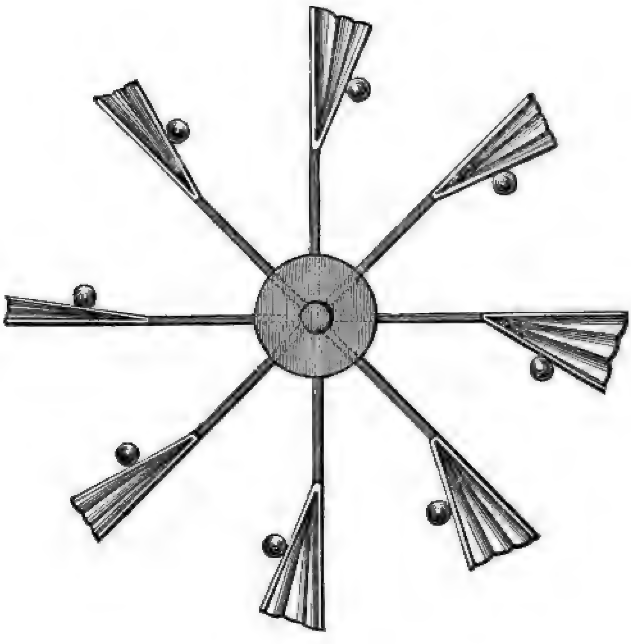


quantity of quicksilver. In consequence of this disposition, the balls or quicksilver must, on the one side, ascend by approaching the centre; and on the other must roll towards

the circumference. The machine then ought to turn incessantly towards that side.

A third machine of this kind is represented Fig. 54. It consists of a kind of wheel formed of six or eight arms, proceeding from a centre, where the axis of motion is placed. Each of these arms is furnished with a receptacle in the form of a pair of bellows, but those on the opposite arms stand in con-

(*Fig.* 54.)



trary directions, as seen in the figure. The moveable top of each receptacle has affixed to it a weight, which shuts it in one situation and opens it in the other. In the last place, the bellows of the opposite arms have a communication by means of a canal, and one of them is filled with quicksilver.

These things being supposed, it is visible, that the bellows on the one side must open, and those on the other must shut;

consequently the mercury will pass from the latter into the former, while the contrary will be the case on the opposite side.

It might be difficult to point out the deficiency of this reasoning; but those acquainted with the true principles of mechanics will not hesitate to bet a hundred to one that the machine, when constructed, will not answer the intended purpose.

The description of a pretended perpetual motion, in which bellows, to be alternately filled with and emptied of quicksilver, were employed, may be seen in the "Journal des Savans" for 1685. It was refuted by Bernouilli and some others, and it gave rise to a long dispute. The best method which the inventor could have employed to defend his invention would have been to construct it, and shew it in motion; but this was never done.

We shall here add another curious anecdote on this subject. One Orfyreus announced, at Leipsic, in the year 1717, a perpetual motion, consisting of a wheel which would continually revolve. This machine was constructed for the Landgrave of Hesse Cassel, who caused it to be shut up in a place of safety, and the door to be sealed with his own seal. At the end of forty days, the door was opened, and the machine was found in motion. This, however, affords no proof in favour of a perpetual motion; for as clocks can be made to go a year without being wound up, Orfyreus's wheel might easily go forty days, and even more.

The result of this pretended discovery is not known. We are informed that an Englishman offered 80,000 crowns for this machine; but Orfyreus refused to sell it at that price: in this he certainly acted wrong, as there is reason to think he obtained by his invention, neither money, nor even the honour of having discovered the perpetual motion.

The Academy of Painting at Paris possessed a clock which had no need of being wound up, and which might be considered as a perpetual motion, though it was not so. But this requires some explanation. The ingenious author of this clock employed the variations in the state of the atmosphere for winding up his moving weight. Various artifices might be devised for this purpose; but this is no more a perpetual motion than if the flux and reflux of the sea were employed to keep the machine continually going; for this

principle of motion is exterior to the machine, and forms no part of it.

But enough has been said on this chimera of mechanics. We sincerely hope that none of our readers will ever lose themselves in the ridiculous and unfortunate labyrinth of such a research.

To conclude, it is false that any reward has been promised by the European Powers to the person who shall discover the perpetual motion; and the case is the same in regard to the quadrature of the circle. It is this idea, no doubt, that excites so many to attempt the solution of these problems; and it is proper they should be undeceived.*

Dr. William Kenrick published "A Lecture on the Perpetual Motion," in 1770 and following year; it is a quarto pamphlet of ninety-two pages, now very rare, a copy of which, however, is in the valuable library connected with the Patent Office. We shall proceed to give it in an abridged form.

In the Apology, occupying six pages, he says :—

The mere exhibition of a self-moving machine, without a display of its mechanism, or the principles on which its motion is begun and continued, could produce no conviction. The fate of Orffyreus and his machine is a proof of this. Scarce fifty years ago that whimsical mechanician exhibited a perpetual motion at Hesse Cassel, the constancy of whose operation was experienced for many weeks under the most exact caution of the Landgrave of that Principality, whose testimony of such operation, as well as in favour of its construction (to the secret of which he was admitted), was given in the most explicit and determinate form. And yet, because Orffyreus would not display the mechanism without the previous assurance of a premium of 200,000 florins (near twenty thousand pounds), or because he would not or could not discover the principles on which it acted, his pretensions were neglected, his machine was destroyed by his own hands, and his life made a sacrifice to the chagrin attending his disappointment. Twenty years had he racked his brains for in-

* Recreations in Mathematics and Natural Philosophy. First composed by M. Ozanam, greatly enlarged by M. Montucla, and translated into English and improved by Chs. Hutton, LL.D. and F.R.S. In 4 vols. 8vo. 1803. [See vol. 2, p. 102 and plate 12.]

vention, and expended a patrimonial competence with parsimony in prosecuting his design. And, when success inspired the hope of reward, he found his ingenuity suspected of imposture, and his industry rewarded with contempt.

Whether any of his successors in the same pursuit will meet with a better fate is at length to be determined. One species of our predecessor's merit, however, I (adds Dr. Kenrick*) presume myself at least entitled to, that of perseverance; it being now fifteen years since I first engaged in this undertaking, which I have since pursued with almost unremitted assiduity, and that not only at a considerable waste of time and expence, but under the constant mortification of hearing it equally ridiculed, by those who do know, and by those who do not know, anything of the matter.

It is, indeed, generally supposed, and as confidently affirmed, that the mathematicians have published demonstrations of the impossibility of a perpetual motion. But I can safely take upon me to affirm that no such demonstration was ever published by any. Within these twelve years past, the mathematicians who deny the possibility of a perpetual motion have been repeatedly and publicly called upon, both in the foreign and English prints, to produce a single instance of these demonstrations. They have not done it. They might have produced, indeed, the demonstrations of Huygens, De la Hire, and others, to prove, as Desaguliers very properly expresses it, the fallacy of the schemes of most of the pretenders to the perpetual motion. They proved nothing more; and this was so far unnecessary, in that the fallacy evidently appeared in the discovery of the principle on which they were founded.

This was done in the last century by the celebrated Marquis of Worcester, in the presence of the King and his Court, at the Tower, by the exhibition of a wheel so contrived that, in revolving on its axis, it carried up several weights nearer its centre on one side than they descended on the other. The scheme was plausible, and to appearance practicable; but, though the wheel was polite enough to turn about while his

* We learn from Gorton's Biographical Dictionary that William Kenrick was born at Watford, and brought up to the business of a rule-maker. He procured a doctor's degree at Leyden, and died in 1779, less lamented than he might have been, owing to his generally malignant and vituperative style of writing.

Majesty was present, it could not be prevailed upon to be so complaisant in his absence.* The mathematicians avenged themselves of the short triumph of the mistaken Marquis, but were equally mistaken themselves in thinking they had routed the problem, or that, in hunting down the jackal, they had destroyed the lion. The perpetual motion survived; it had still its advocates; Professor 'S Gravesande and John Bernouille maintained its practicability, the former giving his testimony in favour of Orffyreus's machine, after a long and scrutinous examination. It is not twelve years since this testimony was republished by Dr. Allaman, the present Professor of Natural Philosophy at Leyden, whose own opinion, given at the same time, is also greatly in favour of the discovery. It is even some years later that a dissertation still more in its favour, written, if I am not mistaken, by the celebrated De Gorter, of Petersberg, appeared in the "Philosophical Transactions" of Haarlem. My end is not to amuse or persuade, but, with due deference, to inform and convince. To remove every cause of objection, I must beg leave to expatiate somewhat at large on the theory of this discovery. It is with the more propriety I presume on this method, as the discovery to which I pretend has not been (as frequently happens) the effect of mechanical accident, but the premeditated result of mathematical reasoning and physical experiment. I shall proceed to elucidate the principal arguments *à priori*, that prove the practicability of a perpetual motion to be the necessary consequence of the known and established laws of nature.

Having proceeded thus far, he opens his lecture at page 7 with the Introduction; and first "On the nature of motion in general," which, in fourteen pages, being more metaphysical than mechanical, affords no extractable matter for our present object. Part 1, is "On the cause and effect of motion." This elementary part is needlessly laboured and elaborated through twenty-seven pages. In the course of his remarks he states:—

The discovery of a perpetual motion, says De la Hire,

* On what authority he presumes to make this statement of its inoperativeness does not appear, and, indeed, seems quite apocryphal.

would be to discover a body at once heavier and lighter than itself. But this is not a fair state of the question. It is not necessary that all the parts of a perpetually-moving machine should be attached to, and inseparable from, each other; which they must be, to constitute one gravitating body of a determinate weight.

He proceeds to consider the nature of the circulation of the blood, pneumatic pressure, the steel-yard, real and relative weight, and spiral action. Again, we have Hobbes, Locke, and Stewart, in the same sentence with such language as—"I could almost as readily impute ingenuity to vegetables and fossils—to the sensitive plant and the loadstone—as mediation to muscles, or cogitabundity to cockles, periwinkles, and rock oysters!" In conclusion, he says:—

I have endeavoured to make it appear that motion is the mechanical effect of the physical action of the primary elements; that the direction of motion only comes within the province of animal intellect; that the vital system is supported by mere mechanic motion, kept up by the elasticity of the solids and the gravity of the fluids composing the animal body; that by the same means a more simple inanimate system or machine may be framed, which may have the same property of continued action (or, as it is called, self-motion). And this is all that is, or can be, expected of a perpetual motion; the momentum of which may be increased to any degree, according to the weight of the bodies employed and the work required to be done.

The second part of this lecture commences with a Proem of thirteen pages:—

I am induced (he says) to trespass farther, by extending in like manner the subsequent divisions of it; making the second and third parts of my printed syllabus the topics of the present reading, and reserving the last part, with the concluding experiment, to the third and final lecture.

I pretend merely to the investigation of the general principles of mechanics, and even to illustrate these so far only as I conceive they relate to the immediate object of my lecture, the discovery of an artificial perpetual motion; leaving

the application of such principles, in the solution of particular phænomena, or the construction of particular machines, to such as make the different arts and sciences their peculiar study.

He very prudently ends, observing:—

But I beg pardon, gentlemen, for the length of this digressive introduction, and shall proceed to the more immediate subject of my lecture.

Section 1, of this lecture, is "On the composition and combination of motion." After discussing, in his own peculiar style, mechanical principles of motion, he adds:—

It would require a volume, and that not a small one, to illustrate these subjects, and support them by the necessary demonstrations and experiments. Should Providence give me life and health, therefore, they (his auditors) shall have it. Indeed, I have already spent some years in preparing such a volume for the press.

He is very prolix on gravity and motion, then commences Section 2, "On the communication and dissipation of motion." Five pages are occupied in discussing motion, in popular language, in the course of which he remarks:—

And as to the imperfectly elastic bodies, their power of retaining or communicating motion depends entirely on their *vis inertiæ* and weight; nor can they on any occasion whatever communicate a greater momentum to another body than they themselves possess. It is sufficient for the purpose of a perpetual motion that they can do this. And, indeed, here all the difficulty lies, viz., in the means of communicating the momentum or moving force of a heavy body to a light one. Now, the most virulent opponents to the practicability of perpetual motion have never pretended to demonstrate the impracticability of this communication. The *quomodo*, or means of effecting it, being the point in dispute. It is to this discovery that I pretend; and to show that my pretensions are well grounded, have taken the liberty to invite you to this lecture.

The lectures appear to have been illustrated by a plate having two figures of a simple apparatus used to demonstrate

the action of a spring and two unequal weights; also an inflexible ruler suspended between two unequal balls,—with both he experimented before his auditors; but the engraving is wanting in the edition now used. In conclusion, he observes:—

You see, gentlemen, I am purposely provided here with a very simple and clumsy apparatus. The perpetual motion does not need the assistance of friction wheels, or depend on the niggling nicety of tooth and pinion. If the practical part of my discovery be not superior to the manual dexterity of a village carpenter or country smith, I am satisfied. There will be no great discernment required to comprehend the design they are to put in execution. You will permit me, however, at present, to defer what I have farther to offer on the subject to another opportunity.*

* A Lecture on the Perpetual Motion. Part the first. London, 1771. 4to. Pp. 49. A Lecture on the Perpetual Motion. Part the second. London, 1771. 4to. Pp. 43. An "Address" follows the first title page, dated 24 Jan, 1771, signed W. Kenrick; and has a notice at the end that "The plates will be delivered with the third and last part of the lecture." This "third and last part," if published, does not form part of the copy in the Patent Office library.

CHAPTER III.

PATENTS OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES, WITH CONTEMPORARY SCIENTIFIC NOTICES ON THEM AND THE SUBJECT GENERALLY.

THE very fact of patenting inventions, ostensibly to go on gravitating without coming to a stand-still, so long as their materials endure, offers fair presumptive evidence of the unfaltering faith of their designers. And the tone of early scientific journals is by no means decidedly averse to offering encouragement to these workers in the dark. We cannot extend these remarks to recent patentees and journalists;—the former generally deceive both themselves and others, and the latter now repudiate such productions.

The following patents belong to the seventeenth century:—

1630.—DAVID RAMSEYE [No. 50], esquire, and one of the Groomes of the Privie Chamber. Among other claims to a patent for "his great paines, industry, and chardge" in finding out the same, he names—"To make any sort of mills to goe on standing waters by continuall mocion, without the helpe of winde, waite, or horse." But no description is given or was then required.

1635.—WILLIAM BARTON [No. 79], gentleman, "by his own invention, labour and expense, hath gained the 'skill of making of engines, which being put in order, will cause and maintain their own motions, with continuance and without any borrowed force of man, horse, wind, river, or brooke, whereby many several kinds of excellent rare works may be performed to the great good and benefit of the commonwealth, the like cause and means of which continuance of motion hath not been heretofore brought to perfection.'"

This patent, granted in the reign of Charles I., for the term of 14 years, is in the usual form to secure the right to the patentee and the payment by him of the annual rent of "tenn pounds" into the Exchequer "att the Feast of the Annunciacion of the Blessed Virgin Marie, att Saint Michaell the Archangell," beyond which, and the above title, nothing is known of the invention itself.

1662.—RALPH WAYNE [No. 135], gentleman, "hath, through his great charge, labour, and industry, attained the knowledge of 'an engine which, with the perpetual motion of it selfe, without the help or strength of any person or creature, will not only drain great levels of vast quantities of water, but also mines of fifty fathoms deep or more.'"

This patent, granted in the reign of Charles II., like the former gives only the title, and requires the yearly payment of four pounds per annum, for 14 years.

Here follow patents of the eighteenth century:—

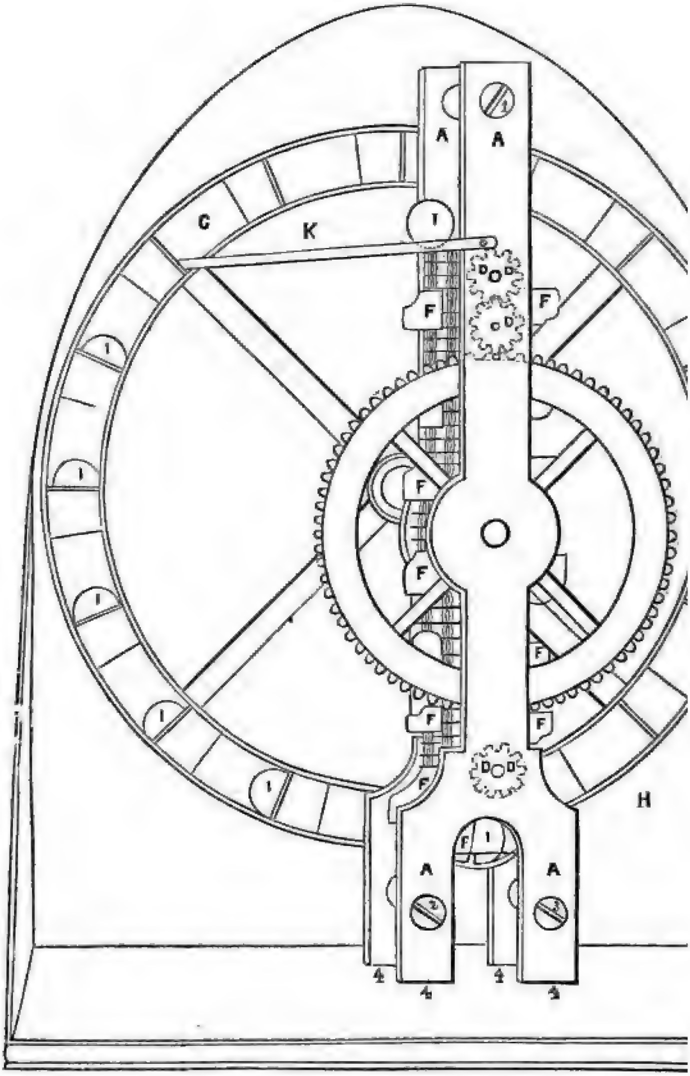
1779.—JOHN DIETRICK MÜLLER [No. 1228], of St. James', Westminster, gentleman. "A machine or engine constructed on self-moving principles." It is "a double wheel, consisting of two frames, fixed on and at right angles to an axis, moving on and supported by two pivots or gudgeons." Each wheel has two or more oval apertures, and boxes and weights made to fit and slide in them, and are to operate on "teeth or trundles," like "a man acting in the wheel of a crane, and thus the powers which are generated in any machine depend upon the exact formation and relative position of these oval holes," &c. &c. &c.

1782.—HILDEBRAND MORLEY [No. 1324], of Clement's Inn, Middlesex, gentleman. "New-invented wheel, engine, or machine, whereby to give or communicate to mills, clocks, timepieces, or other instruments or engines requiring the same properties, a constant and perpetual force and motion."

"My said invented wheel, engine, or machine, whereby

to give or communicate to mills, clocks, timepieces, or other instruments or engines requiring the same properties, a constant and perpetual force and motion, has a framework of wood, iron, or other metal to which the machinery is fixt and supported. It consists of a wheel which is divided on the rim or outward edge into any number of divisions in the manner of a water wheel, so that each division be sufficient to contain a round ball, which balls are made of wood, or hollow balls made of tin, copper, iron, or other metal, or of glass. These balls, as the wheel moves round, fall off on an inclined plane or spout, from whence they acquire sufficient velocity or force to enter through a passage a tall square tube filled either with quicksilver, water, or other fluids, which is there supported by the pressure of the outward air. As soon as those balls enter the aforesaid tube they will rise upwards therein, being lighter than the fluids, and through a certain number of new contrived valves which support the fluids alternately in the tube. When the balls are arrived at the top or broad head of the aforesaid tube, they are conducted to a wheel with a certain number of teeth, on which are placed lifters to lift the balls out of the said fluids. This said wheel is drove by another wheel with the same number of teeth and diameter, to which is joined a pulley, over which passes a cord, chain, catgut, silken thread, or any other line or twist, which, being joined at both ends, is passt over another pulley fixt to the axle of the great wheel, which great wheel, when loaded with the aforesaid balls, turns round the aforesaid two other wheels, by which means the balls are lifted out of and from the fluids, and fall on an inclined plane or spout, which lead to the great wheel. At the lower end of this inclined plane or spout is fixt a small wheel, which is put into motion by spokes fixt on the rim or outward edge of the great wheel, which turns the balls separately on itself to continue the motion."

1786.—Thomas Mead [No. 1543], of Sandwich, Kent, carpenter. "An automaton or machine upon a self-moving principle, which when in motion, will acquire and preserve velocity and force sufficient to work every kind of mill, crane, pump, and all other engines and machines in general, and give motion to any sort of carriage or vessel." This invention con-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sists of "a square frame of wood boarded close on the under side; square posts of wood fixed into the bottom frame and top frame, boarded top and bottom, in which box moves a circular board, carrying the flies, wheel work, &c." And a complicated affair it is, to be sure. However, the patentee says, "When this machinery is to be put in motion, the bottom frame, tube, and box, are to be filled with water, mercury, or some other fluid." How it was intended to work is doubtful; that it never did do duty is certain.

1790.—Conradus Schwiers [No. 1745], of Hoxton, Middlesex, Doctor in Divinity. "A machine on a self-moving principle, or perpetual motion."

"Now know ye, that in obedience of the said letters patent, and the proviso therein contained, I, the said Conradus Schwiers, do hereby declare my said new invented self-moving principle, or perpetual motion, is made and performed in manner following, that is to say:—

"Two stiles or uprights marked in the plan (see opposite page) hereunto annexed, A, A, &c., and fastened together by the screws 1, 2, 3, and to the base at 4, 4, 4, 4, between which stiles or uprights run the wheel C, and the pinion D, and the two double pinions D, D, &c., over which double pinions runs the double chain E, E, &c., to which chain are fixed the bucketts F, F, &c. The chain is made with joints on each side and bars running across, equal in number to the cogs of the wheel C. Upon the same axle with the wheel C, on the farther side of the inner stile A, runs the wheel G, whose diameter is full double that of the wheel C; and the pivot of the wheel G runs in the back H as the other pivot of the same axle runs in the front stile A. The wheel G is divided near the periphery into receptacles in number equal to the buckets on the chain, which receptacles are supplied with metal balls I, I, &c. from the buckets F, F, &c. by means of the gutter K, which balls by their weight forcing round the wheel G, and thereby lifting up the buckets F, F, &c. on one side as they go down on the other side, discharge themselves again at the gutter L, where they are taken up by the buckets F, F, &c., and discharged again at the gutter K, and are so repeated in a constant succession as often as any receptacle is vacant in the wheel G at

the gutter K for their reception, and by that means the perpetual revolution is obtained, the upper ball being at the same time discharged from one bucket when the lower ball is taken up by another." *

1790.—JOHN HAYWOOD [No. 1750], of Long Acre, Middlesex, draftsman and mechanic. "A machine for working mills and engines without the aid of fire, water, or wind, or in aid of all or any of those or any other powers."

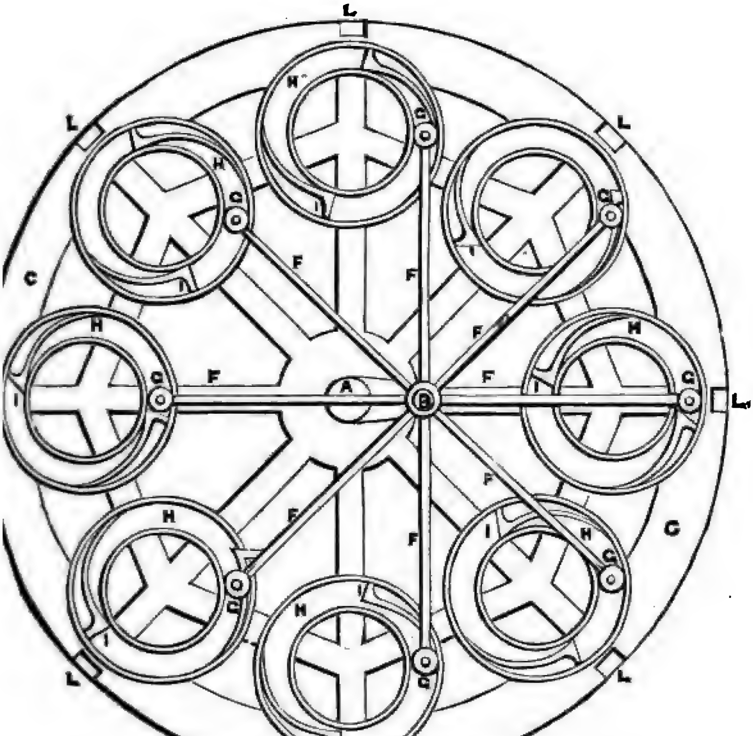
"The machine acts on a rotative principle, or, in other words, has a revolving circular or circulating motion round an axis, center, or centers. It may be made or constructed of any materials or matter whatsoever, so it be of sufficient strength to sustain the power of action when applied to any mill, engine, or machine to which action or motion can or may be communicated by a wheel. The size or dimensions of this machine are by no means confined, but may be varied or altered as circumstances may require.

"References to the drawings of the machine hereunto annexed:—Fig. 1 is the section of the machine. A, A, B, a cranked or double center, fixed to the stand or frame D by the bolts E. C, C, the wheel which turns or revolves round that part of the cranked center mark A. F, levers which turn or revolve round the cranked center B. G, G, rollers or weights which revolve in the circular guides or grooves by means of the leavers F. H, H, circular grooves or guides which are affixed to the inner sides of the wheel. N.B.—The distance from A to B is the radius in all cases to determine the space between the center of the guide or groove H and the center of the roller or weight G. The distance of the two concentric circles which form the guides or grooves H must be equal to the diameter of the roller or weight G. I, I, springs which stop the rollers or weights G from returning when at the horizontal diameter of the wheel. K, weights, which may be increased or diminished at pleasure. L, ledges which connect the sides of the wheel together. N.B.—By fixing cogs or teeth on the rim of the wheel, so as to connect it with any

* Copied from the original specification. The same also occurs in The Repertory of Arts and Manufactures, first series, vol. 7, 8vo., 1797, Art. XXIII., p. 165.

mill, machine, or engine to which motion can be given by a wheel, the power of this machine may be communicated."

(*Fig.* 1.)



1794.—THOMAS MEAD [No. 1979], of Sculcoates, York, engineer. "Certain methods of exerting, putting, and continuing in motion pneumatic chemical or pneumato-chemical apparatus." This is an arrangement of pipes, cylinders, stopcocks, and "a hollow fire grate," of which it would be folly

to quote the description; indeed, the patentee himself complacently states—"it was not for any particular apparatus for which the letters patent were granted!"

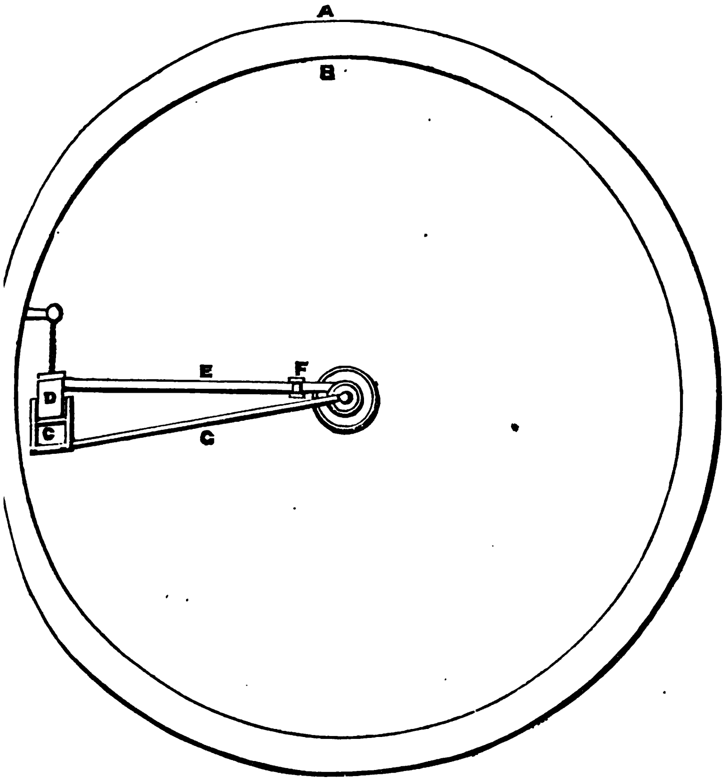
1797.—RICHARD VARLEY [No. 2181], of Damside, Lancashire, merchant. "A new perpetual moving power."

"My invention consists of a method of applying the weight of the atmosphere upon a wheel in any other fluid, and by that means destroying its spring or reaction, the manner of doing which I describe as follows, agreeable to the drawing (Fig. 6) annexed:—

"A is a circular vessel, made of copper or any other substance, capable of containing water, and covered with a top part so as to be perfectly air tight. B is a wheel placed in the inside of the vessel, with its axle perpendicular, the uppermost part of which comes thro' the top of the vessel, and is made to work air-tight; the lower end runs in a step within the vessel, and no part of the wheel is to touch the vessel but its axis. C is a cylinder placed firmly upon the wheel. D is the piston, suspended by a chain to a strong spring fixed on the wheel. This spring is to be made of such strength as that when the whole weight of the atmosphere is upon the piston the air will only move it about one inch down. E is the tube leading from the axle, which is hollow from the top to the level of the wheel, so as to admit the external air by this tube to the piston D, which piston is a circular vessel, made air-tight, and exactly fits the cylinder. There is a joint in the tube E at F, which is made air-tight by leathers, so that when the piston descends the tube may give way to it. G is a small tube leading from the bottom of the cylinder to the center of the axle, and from thence brought out at the end of it, and by which the air is extracted from the cylinder by means of an air pump, and a vacuum formed in it. On the top part, or any other convenient place of the vessel, are fixed two cylinders or tubes, of a proportional size to the cylinders on the wheel, one of which is a condensing cylinder, by means of a screw and piston, and by which the water in the vessel may be compressed; the other has its piston suspended at the bottom, and the top part of the cylinder being filled with air, as the other piston is

screwed down this rises, and condenses the air in the cylinder, the spring of which keeps the water in the vessel pressed to all parts alike; and when the air is extracted from the cylinder

(*Fig.* 6.)



C, and the piston D is forced down by the external atmosphere into the cylinder, this pressure is continued, and the condensed air expands in proportion, and prevents any tendency to a vacuum being formed, which would cause a cohesion of all the parts. By this means the external air is suspended upon the

wheel by the chain, the same as a weight, and the spring of the atmosphere being taken from the cylinder, there is nothing to oppose this weight, there being no spring in water; and this power may be increased in proportion to the size and number of cylinders on the wheel and its diameter."*

The following strictures on Mr. Varley's machine for producing perpetual motion occur in the "Monthly Magazine:"—

On the 23rd May, 1797, letters patent were granted to Mr. Richard Varley, of Damside, Bolton-le-Moor, county of Lancaster, cotton manufacturer, for a machine for producing perpetual motion.

The ignorant and prejudiced part of mankind have in all ages attached a folly to the pursuit of various mysteries of nature and science; such as the ascertaining the longitude at sea, the variation of the magnetic needle, the transmutation of metals, the quadrature of the circle, the adhesion of metallic particles, the repulsion of atmospheric particles, the essential differences between bodies to the exclusion of their attributes, and perpetual motion. The last has been thought, in the general meaning of the term, to be the most chimerical, because all machines are composed of perishable substances.

Mr. Varley's discovery of a new perpetual power appears, however, to promise as much utility as steam, wind, water, or any other force requisite for working mechanical apparatus.

We present our readers beneath with the form of the opened superfices of his apparatus, with this peculiar advantage that it never diminishes its force, while the machine upon which it acts preserves its original form and solidity.

[Here follows a description, as given in foregoing specification.]

Thus, having described the machine, it appears that the principle of the discovery of the new power is effected by "converging the weight of the atmosphere on a wheel in any other fluid, and by that means destroying the repulsive quality, or re-action of the air."

* Copied from the original patent. A copy is published in The Repertory of Arts and Manufactures, 8vo., 1799, vol. 10, first series, p. 9.

The process Mr. Varley pursues in effecting his purpose is as follows :—The copper vessel is filled with water or any other fluid, with the other apparatus in it as before described. It is then closed with the cover, and by means of leather on the edges is made perfectly air-tight. In this condition, with the help of an air-pump, a vacuum is formed in the larger cylinder, over which cylinder is a spring that is acted upon by the condensed air conveyed into the piston through the tube F, and that produces the action of the wheel, because water has no spring.

It is found that upon every square inch of the earth's surface there exists a weight of nearly sixteen pounds of common air, and that a column of mercury, whose elevation will be thirty inches, and its base one cubic inch, will weigh fifteen pounds avoirdupoise, at the rate of eight ounces for every cubic inch of mercury. Since this atmospheric power can be condensed by various means, the formation therefore of the vacuum in the cylinder, and the pressure of the condensed air against it, of course produces the revolution of the wheel, which is the effect sought for.

The cylinders can be increased on the radii, or wheel-spokes, to any weight, as also may the condensed air. Consequently, if a toothed segment or cogged wheel of any description is fitted to it, it will receive the full action of the weight of the atmosphere as its impulsive power, and may be easily applied to any machine in the same manner as if it were acted upon by steam, wind, water, horses, weight, spring, or any description of muscular power necessary to produce motion.*

The following is an editorial Note to Correspondents in "Nicholson's Journal of Philosophy, &c." 4to. 1797. Vol. 1, p. 334:—

I should be glad to give a description and drawing of Mr. Varley's machine for producing perpetual motion, as requested by Mr. Notlem, of Wisbech, if an attentive perusal of the specification enrolled in Chancery had shewn me anything tending to improve the theory or practice of mechanics. The description in the periodical work he mentions is not sufficiently clear to shew the whole of what the writer

* The Monthly Magazine for 1797. Vol. 4 (July No.), p. 58.

meant to explain, and I found the original equally imperfect. Mr. Varley's notion, obscured by some extraneous and unimportant circumstances, appears to be, that if an exhausted cylinder be fixed to one part of the periphery of a wheel, and a piston fitted therein, the pressure of the atmosphere on this last, supposed also to be attached to the wheel by a spring and chain (parallel to a tangent), will tend to drive it into the vacuum, and, if prevented by the shortness of the chain, will draw the wheel round. It is obvious to any person acquainted with statics, that the pressures on his wheel must counterbalance each other, and cannot produce motion.

It has always been easy to shew the fallacy of schemes for perpetual motion in the particular instances; but I have met with no clear enunciation of this project so general as to include every possible scheme, and evince its own absurdity. The difficulty of performing this seems to arise from a want of direct and concise demonstrations of the fundamental principles of the lever, and the equal pressure of fluids in all directions.

Mr. Nicholson, in consequence of Mr. Varley's and Dr. Schwiers' patents, wrote as follows:—

On the Mechanical Projects for affording a Perpetual Motion.

In consequence of the notice* taken of Mr. Varley's attempt to produce a perpetual motion, I have been requested by several correspondents to state how far the mechanical scheme for which Dr. Conrad Shiviers† took out a patent in the year 1790, for the same object, may be worthy of attention. I have, on that occasion, mentioned the difficulties which have prevented any clear general demonstration of the absurdity of this pursuit from being produced, though it has not been difficult to shew the fallacy of the individual plans. It does not, indeed, seem easy to enunciate the scheme itself. What, in universal terms, is the thing proposed to be done? Is it to cause a body to act in such a manner that the re-action shall be greater than the action itself, and by that means generate force by the accumulation of the surplus? Or, can

* Nicholson's Phil. Jour. 4to. Page 334.

† Read—Dr. Schwiers.

the motion communicated be greater than that lost by the agent? Since these positions are evidently contrary to the physical axioms called the laws of nature, and frictions and resistances would speedily destroy all motions of simple uniformity, it may be presumed that S' Gravesande, who thought that all the demonstrations of the absurdity of schemes for perpetual motion contained paralogism, would have stated the proposition under different terms. But, without entering upon this apparently unprofitable disquisition, it may be useful, as well as entertaining, to make a few observations on the mechanical contrivances which depend on a mistaken deduction from the general theorem respecting the balance, among which that of Dr. Shiviers* must be classed.

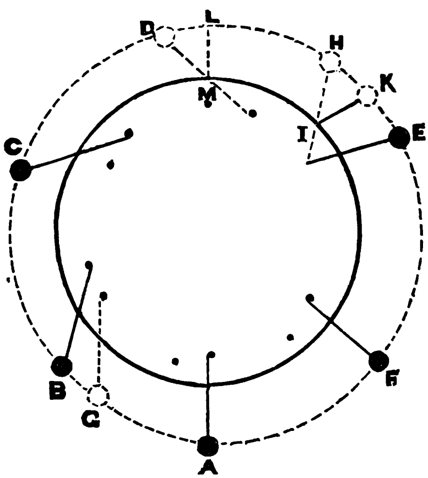
There is no doubt but numerous arrangements have been made, and still are laboured at by various individuals, to produce a machine which shall possess the power of moving itself perpetually, notwithstanding the inevitable loss by friction and resistance of the air. Little, however, of these abortive exertions has been entered upon record. The plans of Bishop Wilkins, the Marquis of Worcester, and M. Orfyreus, are all which at this time occur to my recollection.

There is no doubt but the celebrated Wilkins was a man of learning and ability. His essay towards a real character and a philosophical language is sufficient to render his name immortal. Twenty years before the appearance of that work, he published his "Mathematical Magic," namely, in the year 1648, containing 295 pages, small octavo, which, from the number of copies still in being, I suppose to have been a very popular treatise. It is in this work that I find, among other contrivances for the same purpose, a wheel carrying sixteen loaded arms, similar to that delineated in Fig. 4, plate 15, in which, however, for the sake of simplicity, I have drawn but six. Each lever, A B C D E F, is moveable through an angle of 45°, by a joint near the circumference of the wheel, and the inner end or tail of each is confined by two studs or pins, so that it must either lie in the direction of a radius, or else in the required position of obliquity. If the wheel be now supposed to move in the direction E F, it is evident that the levers A B C D, by hanging in the oblique

* Read—Dr. Schwiers.

position against the antecedent pins, will describe a less circle in their ascent than when, on the other side, they come to descend in the positions E F. Hence, it was expected that the descending weights, having the advantage of a longer lever, would always predominate. Dr. Wilkins, by referring the weights to an horizontal diameter, has shewn that in his machine they will not. A popular notion of this result may also be gathered from the figure, where there are three weights on the ascending, and only two on the descending side; the obliquity of position giving an advantage in point of number, equal to what the other side may possess in

(*Fig.* 4, *pl.* 15.)



intensity. Or, if this contrivance were to be strictly examined, on the supposition that the levers and weights were indefinitely numerous, the question would be determined by shewing that the circular arcs A K, H I, are in equilibrio with the arcs A G, G L.

The simplest method of examining any scheme of this kind with weights, consists in enquiring whether the perpendicular ascents and descents would be performed with equal masses in equal times. If so, there will be no preponder-

ance, and, consequently, no motion. This is clearly the case with the contrivance before us.

The Marquis of Worcester, who will ever be remembered as the inventor of the steam engine, has described a perpetual motion in the fifty-sixth No.* of his "Century of Inventions," published in the year 1655, and since reprinted in 1767 by the Foulis's at Glasgow. His words were as follow:—

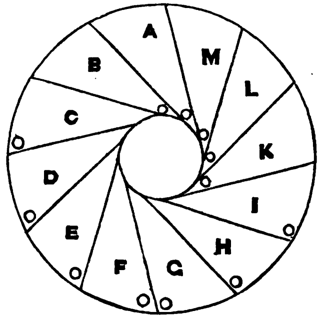
"To provide and make, that all the weights of the descending side of a wheel shall be perpetually further from the centre than those of the mounting side, and yet equal in number and heft to the one side as the other. A most incredible thing if not seen, but tried before the late King (of blessed memory) in the Tower by my directions, two extraordinary ambassadors accompanying his Majesty, and the Duke of Richmond and Duke Hamilton, with most of the Court, attending him. The wheel was fourteen feet over, and forty weights of fifty pounds a-piece. Sir William Balfour, then Lieutenant of the Tower, can justify it with several others. They all saw, that no sooner these great weights passed the diameter line of the lower side, but they hung a foot further from the centre; nor no sooner passed the diameter line of the upper side, but they hung a foot nearer. Be pleased to judge the consequence."

Desaguliers, in his "Course of Experimental Philosophy," vol. 1, page 185, has quoted this passage, and given a sketch of a pretended self-moving wheel, similar to Fig. 5, plate 15, as resembling the contrivance mentioned by the Marquis of Worcester. The description of this last engineer agrees, however, somewhat better with the contrivance Fig. 4. It must, of course, be a mistake in terms, when he says the weight receded from the centre at the lower diameter, and approached towards it at the upper: the contrary being in fact necessary to afford any hope of success; and accordingly in the quotation it is so stated. I am, therefore, disposed to think that Fig. 5 represents the wheel of Orfyreus at Hesse Cassel, much talked of about the year 1720, and which probably was made to revolve, during the time of exhibition, by some concealed apparatus. It consists of a number of cells or partitions, distinguished by the letters of the alphabet, which are made between the interior and exterior surfaces of two concentric

* 1663 is the date of the first printed edition, and 1659 date of the MS.

cylinders. The partitions being placed obliquely with respect to the radius, a cylindrical or spherical weight placed on each,

(*Fig.* 5, *pl.* 15.)



it is seen from the figure, that these weights will lie against the inner surface of the large cylinder whenever the outer end of the bottom partition of any cell is lowest; and, on the contrary, when that extremity is highest, the weight will rest on the surface of the interior cylinder. Let the wheel be made to revolve in the direction A B C; the weights in C D E F G H I being close to the external circle, and the weights K L M A B close to the inner, for the reasons last mentioned. As the cell B descends, its weight will likewise run out, at the same time that the weight in the cell I will run in, in consequence of its partition being elevated. By the continuation of this process, since all the weights on the descending side pass down at a greater distance from the centre, while those of the ascending side rise for a considerable part of their ascent at a less distance from the same point, it is concluded that the wheel will continue to maintain its motion. On this, however, it is to be remarked, that the perpendicular ascent and descent are alike, both in measure and in time of performance; and that the familiar examination, even to those who know little of such subjects, is sufficient to show that the preponderance is not quite so palpable as at first it appears. For the weights G and F, H and E, I and D are evidently in equilibrio, because at the same horizontal distance from the centre; and if the favourable supposition that

the weight B hath already run out be admitted, it will then remain a question whether these two exterior weights, B and C, can preponderate over the four inner weights, K L M A. The more accurate examination of this particular contrivance will lead to the following theorem:—In two concentric circles, if tangents be drawn at the extreme points of a diameter of the smaller, and continued till they intersect the larger, the common centre of gravity of the arc of the greater circle included between the tangents, and of the half periphery of the smaller circle on the opposite side of the diameter, will be the common centre of the circles. If, therefore, the balls were indefinitely numerous and small, the supposed effective parts of the wheel (Fig. 5) would be in equilibrio, as well as the parts beneath the horizontal tangent of the inner circle.

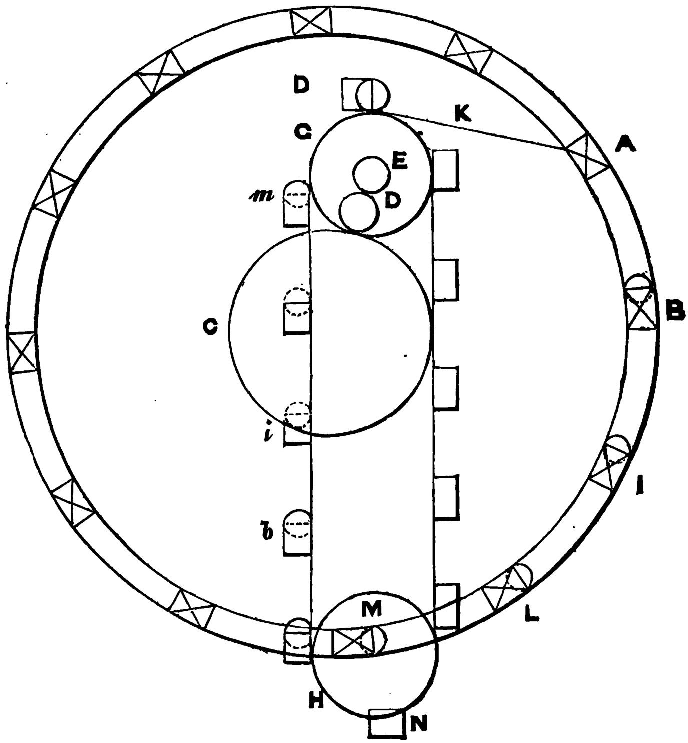
Fig. 6 represents the contrivance of Dr. Shiviers,* which, in a periodical publication, in other particulars respectable, has been said to continue in motion for weeks and even months together. There is not the smallest probability that it should continue in motion for half a minute, or nearly as long as a simple wheel would retain part of its first impulse. The external circle denotes a wheel carrying a number of buckets, A B I L, &c. C represents a toothed wheel, on the same axis, which drives a pinion D; and this last drives another pinion E upon the axis of a lanthorn, or wheel intended to work a chain-pump with the same number of buckets as in the larger wheel A B I. The lanthorn G is made of such a size as to receive the buckets *a b i l* with a due velocity. K represents a gutter, through which a metallic ball, contained in the bucket *m*, may run and lodge itself in the bucket A of the wheel. Each of the buckets of the wheel, B I L M, which are below the gutter, is supplied with a metallic ball, and so likewise are the ascending buckets, *a b i l m*, of the chain-pump. As the pump supplies the wheel, it is again supplied at M, where the balls fall into its ascending buckets. Now, it is presumed that the balls in the wheel, I suppose on account of their distance from the centre of motion, will descend with more than sufficient force to raise those on the chain, and, consequently, that the motion will be perpetual.

The deception in this contrivance has much less seduction than in the two foregoing, because it is more easily referred

* Should be Dr. Schwiers. The patent bears date 1790 [No. 1745].

to the simple lever. This, like the others, exhibits no prospect of success, when tried by the simple consideration of

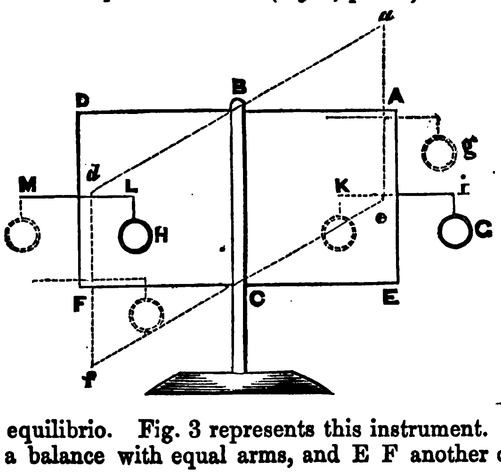
(*Fig*. 6, *pl*. 15.)



the equality of the ascent and descent in the whole time of the rotation of a single ball. It may also be shewn, from the principles of wheel-work, which are familiar to artisans, that whatever is gained by the excess of the diameter of the great wheel beyond that of the wheel C, is again lost by the excess of the lanthorn A beyond the pinion E.

The fundamental proposition of the simple lever or balance, that equal bodies at an equal distance from the fulcrum will equiponderate, but that at unequal distances the most remote will descend, has in these and numberless other instances led mechanical workmen and speculators to pursue this fruitless enquiry with labour and expense often ill-afforded, and with a degree of anxiety and infatuation which can hardly be conceived by those who have never suffered the pain of hope long deferred. For this reason chiefly, it has appeared desirable and useful to treat the subject in a familiar way, without descending to those expressions of contempt, which ignorance, harmless to all but itself, is surely not entitled to. If such reasoners were well convinced that the power of a machine is to be estimated by the excess of motion referred to the perpendicular, without any regard to the apparent centre of the machine, and that in machines very little compounded it is possible to produce effects directly contrary to the rule which is true of the simple lever, they would probably renounce many flattering projects, grounded only on the supposition of its universality. Desaguliers contrived an apparatus in which two equal weights may be placed at any distance whatever from the centre of motion, and still con-

Compound Balance. (*Fig.* 3, *pl.* 15.)

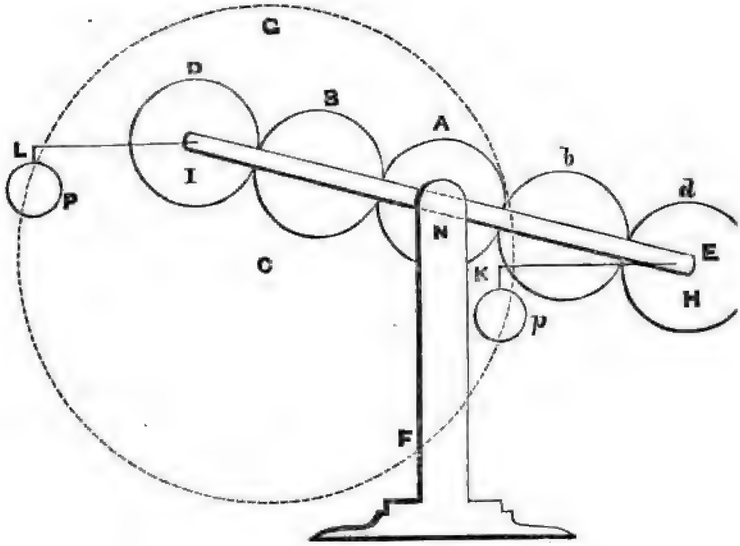


tinue in equilibrio. Fig. 3 represents this instrument. A D denotes a balance with equal arms, and E F another of the

same dimensions. These move on the centres B and C, and are connected by the inflexible rods A E and D F; the motion being left free by means of joints at the corners. Across the rods A D, E F, are fixed two bars, I K, L M. Now, it is unnecessary to shew that the weight G will describe exactly the same line or circular arc, when the levers are moved into the position *a d f e*, or any other position, as it would have described in case it had been suspended at A, or K, or E; and that it is of no consequence in this respect at what part of the line A E or I K it be fixed. The same observations are true of the weight H on the other side. And accordingly it is found that these equal weights may be suspended anywhere on the lines I K and L M without altering their equilibrium.

By this contrivance it is most evidently proved, to those who are totally unacquainted with the theory, that weights do not preponderate in compound engines, on account of their distance from the centre. Several other contrivances may be made to the same effect. The following combination of

(*Fig.* 2, *pl.* 15.)



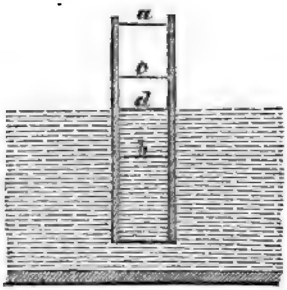
wheel-work presented itself to me as one which would most probably be mistaken for a perpetual motion. (Fig. 2, plate 15.) The five circles represent the same number of wheels, of equal diameter and number of teeth, acting together. The middle wheel A is fixed between two upright pillars, so that it cannot revolve. The other four wheels are pinned in a frame H I, in which they can revolve, and through which the axis of A likewise passes. From the extremity of the axis of D, and also of *d*, proceed the horizontal levers H K and I L, which are equal, and point in the same direction parallel to the plane of the wheels. At the extremity of these arms hang the equal weights P and *p*. Let it now be imagined that the end I of the frame is depressed, the wheel B will turn round by the re-action of the fixed wheel A in the same direction as H I, and it will make one revolution in the same time relative to the frame, or two with regard to absolute space, by reason of its being carried round. The action of B upon D will produce a rotation relative to the frame in the opposite direction during the same time. Instead, therefore, of two revolutions, like the wheel B, this wheel D, with regard to absolute space, will not revolve at all, and in every position of the apparatus the arm I L will continue horizontal, and point the same way. For similar reasons, the arm H K will retain its position. Consequently, it is seen that the descending weight will move at a great horizontal distance from the centre N, while the ascending weight rises very near that centre. But there will not on this account be a perpetual motion: for the action of the levers H K and I L upon the frame H I, by means of the toothed wheels, will in the detail be found precisely alike, and in the general consideration of the motions of P and *p*, the opposite motions in the circle E F G will be accurately the same.

It has always been considered as essential to a perpetual motion, that it should be derived from some energy which is not supposed to vary in its intensity. Such are the inertia, the gravity or magnetism of bodies. For an occasional or periodical variation of intensity in any force is evidently productive of motion, which requires only to be accumulated or applied, and the apparatus for applying it cannot be considered as a machine for perpetual motion. Neither, in strictness, can any machine whose motion is derived from the rotation of the earth, and the consequent change of seasons

and rotation of events, be so considered, because it does not generate, but only communicates. The perpetual flow of rivers; the vicissitudes of the tides; the constant, periodical and variable winds; the expansions and contractions of air, mercury, or other fluids, by daily or other changes of temperature; the differences of expansions in metals, by the same change; the rise and fall of the mercury in the barometer; the hygrometric changes in the remains of organized beings, and every other mutation which continually happens around us, may be applied to give motiôn to mills, clocks, and other engines, which may be contrived to endure as long as the apparatus retains its figure.*

1801.—*Specification of the Patent granted to Joseph Gaston John Baptiste,* COUNT DE THIVILLE [2472], *of Piccadilly, in the County of Middlesex, for "Certain new methods of giving an independent moving power to all machines, by means of hydraulic engines; and also of constructing and employing separately several of their parts, such as wheels, pistons, and apparatus for reducing friction, upon new principles."—Dated February* 5, 1801.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I, the said Joseph Gaston John Baptiste, Count de Thiville, do hereby declare, that my said invention consists in the application of certain hydrostatical principles not at all or but little known till now, which contrary to the laws of statics in solid bodies, give to incompressible fluids the property of rising almost spontaneously above the place from which they have fallen. Without accounting for the causes, I will confine myself to effects founded on experiments, and give some specimens of these principles, and of the consequences resulting therefrom. Let Fig. 1 be an empty tube, and stopped at bottom or top



(*Fig.* 1, *pl.* 14.)

* A Journal of Natural Philosophy, Chemistry, and the Arts. By William Nicholson. Vol. 1. 4to. 1797. Page 375.

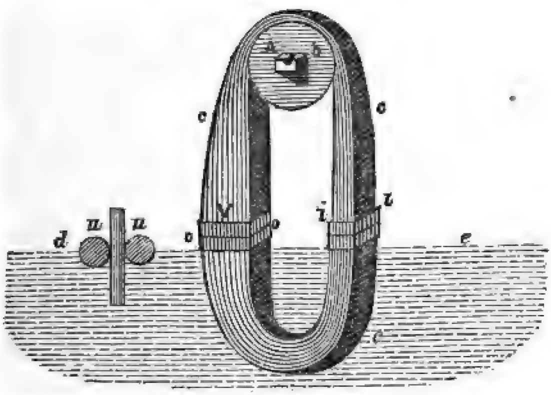
air-tight. If it be immersed into water and suddenly opened, the fluid will rise to *a*, fall to *b*, rise again to *c*, and so on till it fix itself at *d*, which is the level of the fluid.

[He then proceeds to describe Fig. 2 as "a vertical section of a chest fastened in a large reservoir or pond." Four other figures are given to illustrate this plan on the preceding principle of giving motion to machinery. That he had not reduced his plans to practice, appears from the following:—]

At what height, in what quantity, and at what expence of power can the water be raised, are likewise liable to great variations, and can only be ascertained by experiments on large scales, and in open water.

[Some "Observations by the Patentee" are added, on "Friction in Fluids," on "Resistance of Fluids," and]

Perpetual Motion.—Without prejudging anything upon the principles I have introduced in my specification,—which principles I consider as a theorem from which every one may draw the corollaries,—I will confine myself within the limits I have prescribed, and propose the following problem:—



(*Fig.* 13, *pl.* 14.)

Let A (Fig. 13) be a wheel or cylinder turning on its gudgeon *b*; *c c c* is an assemblage of sheets of any material

or stuff; these sheets pass between thin plates or wires fastened in a fixed box, *i i;* at *o o* they pass freely between small cylinders or rollers, turning in another fixed box, V. Instead of being so separated, they may be pressed close to each other by passing between two rollers, *u u.* Thus, the apparatus being so disposed, and the level of the water being as at *d e*, I say the phenomenon of spontaneous ascent of fluids in capillary tubes or spaces, ought to take place between the sheets at *i i;* and it ought not to do so at *o o*, or at *u u*, by their being too close to or distant from each other. That being established, I represent by Y the power acquired by the ascent of the fluid at *i i;* I represent by Z the mechanical resistance occasioned by the rubbing of the sheets against the cylinders at *o o*, or by their pressure at *u u*. Now, I ask how, and at what point, the laws which preside over the phenomena of nature at *i i*, and those which regulate the mechanical effect at *o o* or *u u*, coincide so as to determine a constant ratio between the power and the resistance; and finally, what is the ratio between Y and Z.

It is obvious that if Z is greater than or equal to Y, the machine will remain immovable. If, on the contrary, Y is greater than Z, the machine once put in motion will never stop.*

* The Repertory of Arts and Manufactures. 8vo. 1801. Vol. 14, p. 289.

CHAPTER IV.

EARLY PAPERS FROM THE PHILOSOPHICAL TRANSACTIONS, AND SIR ROBERT BOYLE; ALSO THE PARIS ACADEMY OF SCIENCES, WITH NOTICES OF COMMUNICATIONS TO THE ACADEMY, 1837-56.

NOTHING later than 1733 appears to have been brought before the Royal Society on Perpetual Motion, and the following papers are chiefly remarkable as being derived from its Transactions:—

Observations of Dr. Papin, Fellow of the Royal Society, on a French Paper concerning a Perpetual Motion.

The paper printed in French, and containing a contrivance for perpetual motion, being set down in such a manner that can hardly be understood but by those that are much acquainted with such descriptions, I have endeavour'd to explain it as follows:—

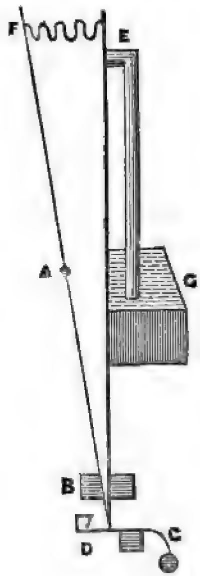
Let D E F be a pair of bellows forty inches long, that may be open'd by removing the part F from E; let them be exactly shut everywhere but at the aperture E; and let a pipe E G, twenty or twenty-two inches long, be soldered to the sayd aperture E, having its other end in a vessel G, full of mercury, and placed near the middle of the bellows.

A is an axis for the bellows to turn upon.

B, a counterpoise fastened to the lower end of the bellows.

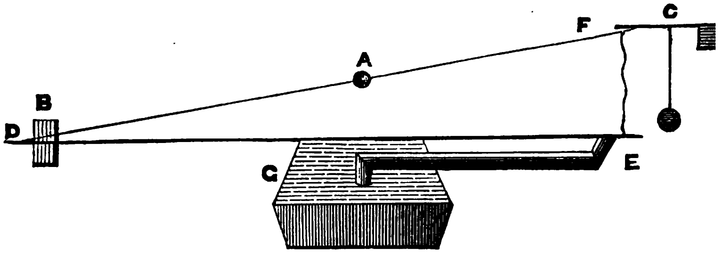
C, a weight with a clasp to keep the bellows upright.

Now, if we suppose the bellows open'd only to $\frac{1}{8}$ or $\frac{1}{4}$, standing upright, and full of mercury, it is plain that the sayd mercury, being forty inches high, must fall, as in the Torricellian experiment, to the height of about twenty-seven inches, and, consequently, the bellows must open towards F, and leave a vacuity there. This vacuity must be



(*Fig.* 184, *pl.* 5.)

fill'd with the mercury ascending from G through the pipe G E, the sayd pipe being but twenty-two inches long; by this means the bellows must be opened more and more, till the mercury continuing to ascend makes the upper part of the bellows so heavy that the lower part must get loose from the clasp C, and the bellows should turn quite upside down; but



(*Fig.* 185, *pl.* 5.)

the vessel G being set in a convenient place, keeps them horizontal, and the part F engageth there in another clasp C; then the mercury, by its weight, runs out from the bellows into the vessel G through the pipe E G, and the bellows must shut closer and closer untill the part E F comes to be so light that the counterpoise B is able to make the part F get loose from the clasp C; then the bellows come to be upright again; the mercury left in them falls again to the height of twenty-seven inches, and, consequently, all the other effects will follow as we have already seen, and the motion will continue for ever. Thus much for the French author.

Upon this it is to be observed, that the bellows can never be opened by the internal pressure, unless the sayd pressure be stronger then the externall; now, in this case, the weight of the atmosphere doth freely press up the outward part of the bellows, but it cannot come at the inward part but through the pipe G E, which, containing twenty-two perpendicular inches of mercury, doth counterpoise so much of the weight of the atmosphere, so that this being supposed to be twenty-seven inches of mercury, it cannot press the inward part of the bellows but with a weight equivalent to five perpendicular inches of mercury. From this we may conclude,

that the pressure of the atmosphere, being weakened within the bellows more then it can be helpt by the mercury contain'd in the same, as may easily be computed, the sayd bellows standing upright must rather shut then open. Thus, without losing any labour and charges in trying, people may be sure that the thing can never do.*

Some further Remarks on the Instrument proposed by an Anomymous French Author for effecting a Perpetual Motion, an account whereof is given in No. 177 of these Transactions. By Dr. Papin, M.D., R.S.S.

Having seen in the "Journal des Savans" of May 13, and in the "Nouvelles de la Republique des Lettres" of the month of June, that the author of the perpetual motion is not satisfied, but doth endeavour to answer the objection that I propounded against his contrivance in the "Philosophical Transactions" of the month of December, 1685, I find I must explain myself more at large than I did in that paper; but I begg his pardon if I say nothing concerning the new disposition which he says might be given to his engine. My want of time makes me avoid new matters of dispute, and I think it enough for me, if I do but shew that his first description can never succeed.

I am very sorry that this author took so much trouble in trying his bellows with several liquors, as oyl, mercury, water. I thought I had sayd nothing that might make him believe that I did in the least question the truth, which he intended to prove against me by those experiments; and without any tryals I am fully enough convinced, that the mercury in his engine must follow the laws of the æquilibrium of fluid bodies. But the consequence which he draws from that principle seems to me very groundless; for, altho' the lowermost part of the bellows be presst by the weight of forty inches of mercury, it doth not follow that all the parts which are situated higher must bear the same pressure. To the quite contrary, it is plain that the upper part, having no mercury above it, bears none at all; the parts that lye in the middle near the axes of the bellows bear but twenty inches, and so all the

* The Philosophical Transactions. Vol. 15, for the year 1685. 4to. Page 1240. Also, the Phil. Trans. and Collections to the end of the year 1700, abridged, in 3 vols. By John Lowthorp, M.A. and F.R.S. Vol. 1, 4to., 1705, p. 592.

rest must bear more or less according as they lye higher or lower. It is evident, therefore, that there are as many parts that bear less then twenty inches as there are that bear more, and the increase of pressure following an arithmetical progression, it is undenyable that all these pressures added together will do no more than one uniform pressure that would be equal to twenty inches everywhere.

Having thus found the quantity of pressure caused by the mercury within the bellows, we must remember that the pressure of the atmosphere within the same bellows is equivalent but to five inches, as I observed in my first paper, *vid.* "Philosophical Transaction," No. 177, page 1241: so that we find that the inward pressure is equivalent but to twenty-five inches of mercury in all. Now, the pressure of the atmosphere upon the outside is everywhere equal to twenty-seven inches; from whence it appears that the pressure without is stronger than the pressure within, and so I had reason to say, that the bellows standing upright, must rather shut than open.

I did not think to have given this computation so at large, but I have been necessitated to do it (as I said in the beginning), since my first paper was not sufficient to make me be understood by the author of the perpetual motion. However, I will be careful to save the time of the reader as much as I can; and although I might observe some other things in his description that will increase the difficulty of opening the bellows, I forbear to speak of them, and I will stick only to that which is most material, and make his perpetual motion to be altogether impossible.

As for the argument the author drawes from comparing his engine to an ordinary siphon, I do beseech him to consider what a difference there is between a siphon that lets the water run down at the bottom, and his engine, that should gather up the heavy liquor into the highest part of the instrument, and I do not question but he will acknowledge the weakness of this argument.*

An answer of Dr. Papin to the Author of the Perpetual Motion.

In the last papers I published in "Philosophical Transaction" No. 184, against this perpetual motion described in

* The Philosophical Transactions. Vol. 16, for the years 1686 and 1687. No 182, June, 1686, p. 138.

No. 177, I intreated the author to permit me to say nothing as to what alterations he might make in his engine, resolving to leave it to others to shew him that upon that principle all he can do signifies nothing. But I find since, in the "Nouvelles de la Republique" for December last, that he still persists to urge some new contrivances, which being added, he conceives his engine must succeed. To this I answer, that I undertook only to shew that his first device would faile, which yet I should scarce have done if I had thought a dispute of this nature could have lasted so long. To come, therefore, to the point where he saith that this engine may well succeed without alteration, because he hath tryed with liquors put into bellows immersed in water; I again say that I grant him the truth of the experiments, but deny the consequences he would draw from them. I have already given the reasons of my dissent, which this gentleman is not pleased to understand. But to end all controversies, he may please to consult Mr. Perrault, De la Hire, or any other at Paris well known to be skilled in hydraulicks, and I doubt not but he will find them of the same opinion with Mr. Boyle, Mr. Hook, and other knowing persons here, who all agree that our author is in this matter under a mistake.*

A Proposition on the Balance, not taken notice of by Mechanical Writers, explained and confirmed by an Experiment. By the Rev. J. T. Desaguliers, LL.D., F.R.S.

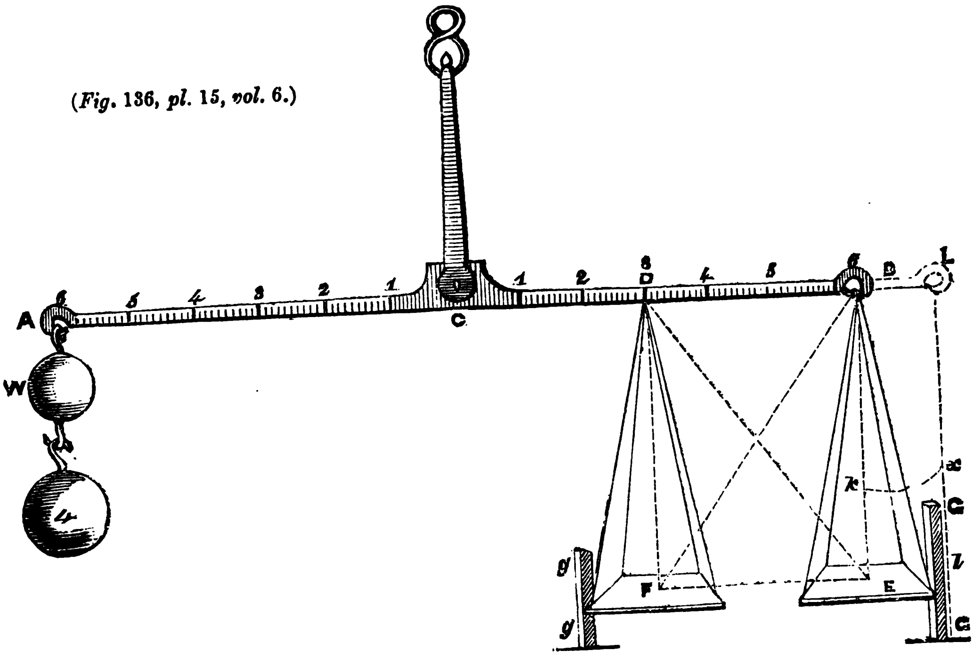
THEOR. 6.—A B is a balance, on which is supposed to hang at one end, B, the scale E, with a man in it, who is counterpoised by the weight W hanging at A, the other end of the balance. I say, that if such a man, with a cane or any rigid straight body, pushes upwards against the beam anywhere between the points C and B (provided he does not push directly against B), he will thereby make himself heavier, or overpoise the weight W, though the stop G G hinders the scale E from being thrust outwards from C towards G G. I say likewise, that if the scale and man should hang from D, the man, by pushing upwards against B, or anywhere between B and D (provided he does not push directly against D), will make himself lighter, or be

* The Philosophical Transactions. Vol. 16, 1686-7. No. 186, January, 1687, p. 267.

overpoised by the weight W, which before did only counterpoise the weight of his body and the scale.

If the common center of gravity of the scale E, and the man supposed to stand in it, be at *k*, and the man, by thrusting against any part of the beam, cause the scale to move outwards so as to carry the said common center of gravity to *k x*, then, instead of B E, L *l* will become the line of direction of the compound weight, whose action will be increased in the ratio of L C to B C. This is what has been explained by several writers of mechanics; but no one, that I know of, has considered the case when the scale is kept from flying out, as here by the post G G, which keeps it in its place, as if the strings of the scale were become inflexible. Now, to explain this case, let us suppose the length B D of half of the brachium B C to be equal to 3 feet, the line B E to 4 feet, the line E D of 5 feet to be the direction in which the man pushes, D F and F E to be respectively equal and parallel to B E and B D, and the whole or absolute force with which the man pushes equal to (or able to rise) 10 stone. Let the oblique force E D (= 10 stone) be resolved into the two E F and E B (or its equal F D) whose directions are at right angles to each other, and whose respective quantities (or intensities) are as 6 and 8, because E F and B E are in that proportion to each other and to E D. Now, since E F is parallel to B D C A, the beam, it does no way affect the beam to move it upwards; and therefore there is only the force represented by F D, or 8 stone, to push the beam upwards at D. For the same reason, and because action and reaction are equal, the scale will be pushed down at E with the force of 8 stone also. Now, since the force at E pulls the beam perpendicularly downwards from the point B, distant from C the whole length of the brachium B C, its action downwards will not be diminished, but may be expressed by $\overline{8 \times B\,C}$; whereas the action upwards against D will be half lost, by reason of the diminished distance from the center, and is only to be expressed by $\overline{8 \times \frac{B\,C}{2}}$; and when the action upwards to raise the beam is substracted from the action downwards to depress it, there will still remain 4 stone to push down the scale; because $8 \times B\,C - \overline{8 \times \frac{B\,C}{2}} = 4\ B\,C$. Consequently, a weight of 4 stone must be added at the end

(*Fig.* 136, *pl.* 15, *vol.* 6.)



A to restore the æquilibrium. Therefore a man, &c., pushing upwards under the beam between B and D, becomes heavier. Q.E.D.

On the contrary, if the scale should hang at F, from the point D, only 3 feet from the center of motion C, and a post G G hinders the scale from being pushed inwards towards C, then, if a man in this scale F pushes obliquely against B with the oblique force above mentioned, the whole force, for the reasons before given (in resolving the oblique force into two others acting in lines perpendicular to each other) will be reduced to 8 stone, which pushes the beam directly upwards at B, while the same force of 8 stone draws it directly down at D towards F. But as C D is only equal to half of C B, the force at D, compared with that at B, loses half its action, and therefore can only take off the force of 4 stone from the push upwards at B; and consequently the weight W at A will preponderate, unless an additional weight of 4 stone be hanged at B. Therefore, a man, &c., pushing upwards under the beam between B and D, becomes lighter.*

[The paper concludes with some further rules and experiments.]

An Experiment explaining a Mechanical Paradox, that two bodies of equal weight suspended on a certain sort of balance do not lose their æquilibrium by being removed, one farther from, the other nearer to, the center. By the Rev. J. T. Desaguliers, LL.D., F.R.S.

Prop. 7.—If the two weights P W hang at the ends of the balance A B, whose center of motion is C, those weights will act against each other (because their directions are contrary) with forces made up of the quantity of matter in each multiplied by its velocity; that is, by the velocity which the motion of the balance turning about C will give to the body suspended. Now, the velocity of a heavy body is its perpendicular ascent or descent, as will appear by moving the balance into the position *a b*, which shews the velocity of P to be the perpendicular line *e a*, and the velocity of B will be the perpendicular line *b g*; for if the weights P and W are equal, and also the lines *e a* and *b g*, their momenta, made up of *e a* multiplied into

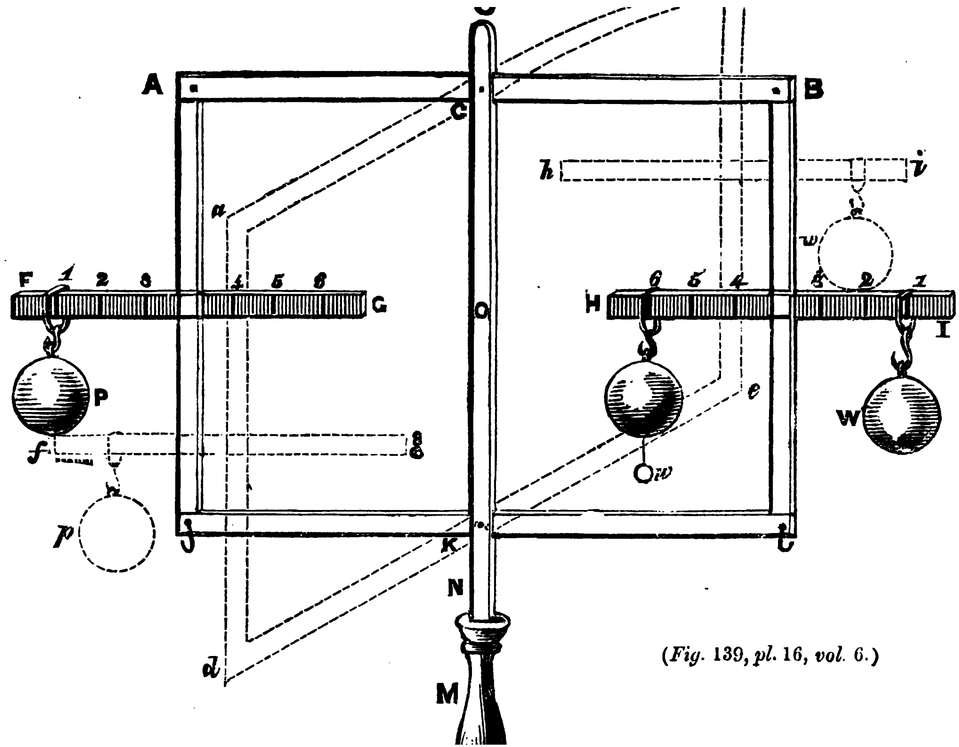
* The Philosophical Transactions, from 1719 to 1733, abridged. 4to. London, 1734. Vol. 6, p. 306.

W, and *b g* multiplied into P, will be equal, as will appear by their destroying one another in making an equilibrium. But if the body W was removed to M, and suspended at the point D, then, its velocity being only *f d*, it would be overbalanced by the body P, because *f d* multiplied into M would produce a less momentum than P multiplied into *b g*.

As the arcs A *a*, B *b*, and D *d*, described by the ends of the balance or points of suspension, are proportionable to their sines *e a*, *g b*, and *d f*, as also the radii or distances C A, C B, and C D; in the case of this common sort of balance, the arcs described by the weights, or their points of suspension, or the distances from the center, may be taken for velocities of the weights hanging at A, B, or D, and therefore the acting force of the weights will be reciprocally as their distances from the center.

Scholium.—The distances from the center are taken here for the velocities of the bodies, only because they are proportionable to the lines *e a*, *b g*, and *f d*, which are the true velocities; for there are a great many cases wherein the velocities are neither proportionable to the distances from the center of motion of a machine, nor to the arcs described by the weights or their points of suspension. Therefore, it is not a general rule that weights act in proportion to their distances from the center of motion; but a corollary of the general rule that weights act in proportion to their velocities, which is only true in some cases. Therefore, we must not take this case as a principle, which most workmen do, and all those people who make attempts to find the perpetual motion, as I have more amply shewn in the Phil. Trans., No. 369.

But to make this evident even in the balance, we need only take notice of the following experiment:—A C B E K D is a balance in the form of a parallelogram passing through a slit in the upright piece N O standing on the pedestal M, so as to be moveable upon the center pins C and K. To the upright pieces A D and B E of this balance are fixed at right angles the horizontal pieces F G and H I. That the equal weights P W must keep each other in æquilibrio, is evident; but it does not at first appear so plainly, that if W be removed to V, being suspended at 6, yet it shall still keep P in æquilibrio, though the experiment shews it. Nay, if W be successively moved to any of the points 1, 2, 3, E, 4, 5, or 6, the æquilibrium will be continued; or if, W hanging at any



(*Fig.* 139, *pl.* 16, *vol.* 6.)

of those points, P be successively moved to D, or any of the points of suspension on the cross piece F G, P will at any of those places make an æquilibrium with W. Now, when the weights are at P and V, if the least weight that is capable to overcome the friction at the points of suspension C and K be added to V, as *u*, the weight V will overpower, and that as much at V as if it was at W.

From what we have said above, the reason of this experiment will be very plain.

As the lines A C and K D, C B and K E, always continue of the same length in any position of the machine, the pieces A D and B E will always continue parallel to one another, and perpendicular to the horizon. However, the whole machine turns upon the points C and K, as appears by bringing the balance to any other position, as *a b e d;* and therefore, as the weights applied to any part of the pieces F G and H I can only bring down the pieces A D and B E perpendicularly, in the same manner as if they were applied to the hooks D and E, or to X and Y, the centers of gravity of A D and B E, the force of the weights (if their quantity of matter is equal) will be equal, because their velocities will be their perpendicular ascent or descent, which will always be as the equal lines 4 *l* and 4 L, whatever part of the pieces F G and H I the weights are applied to. But if to the weight at V be added the little weight *u*, those two weights will overpower, because in this case the momentum is made up of the sum of V and *u* multiplied by the common velocity 4 L.

Hence follows, that it is not the distance C 6 multiplied into the weight V which makes its momentum, but its perpendicular velocity L 4 multiplied into its mass. Q.E.D.

This is still further evident by taking out the pin at K; for then the weight P will overbalance the other weight at V, because then their perpendicular ascent and descent will not be equal.*

* The Philosophical Transactions, from 1719 to 1733, abridged. 4to. London, 1734. Vol. 6, p. 310. Another paper by Dr Desaguliers, being "Remarks on some attempts made towards a Perpetual Motion," from the Phil. Trans, abridged, 4to., 1734, vol. 6, p. 323, will be found transferred to Chapter II.

An Historical Account of a strangely Self-moving Liquor. Printed first in the Philosophical Transactions, No. 176, p. 1188, anno 1685, vol. 15.

An ingenious teacher of mathematicks, having occasion to make a composition for a new fire-engine, whereof he was to shew his Majesty a trial, mingled divers ingredients in an earthen pot over kindled coals; but could not or did not do it so warily, but that the matter took fire, and began to blaze furiously, which obliged him to stifle the blaze as hastily as he could; and having removed the vessel from the fire, and suffered it to grow cold, when afterwards he came to look upon it, to see if what remained might be of any use to him, he was surprised to find it variously and briskly moved. Wherefore, having set it aside, to be sure that it might be thoroughly cold, he, after some hours, visited it again, and found it move as before; and having cast store of seeds upon it, to see if the liquor would move them also, the bituminous part of it connected them into a kind of thick scum, that covered most of the superfices, but yet left some intervals, in which the liquor appeared, and discovered that it continued its motions. Two days after, the engineer discoursing with me of this fire-work, about which he had advised with me before, told me, among other things, of this odd accident. And when I asked him if the motion continued still, and had been answered affirmatively, though it was then a dark night and ill weather, my diffidence or my curiosity made me engage him to send for the pot as it was, partly to be sure of the matter of fact, and partly to try if the knowledge I had of the ingredients, which he had before told me, would afford any hint of the cause of so odd an effect; a like to which in kind, though not in degree, I had many years before devised, and successfully practised, the way of producing.

The vessel being come, though the hasty transportation of it seemed to have sufficiently disturbed it, there did appear manifest signs of such a motion as the engineer had ascribed to it; and, therefore, he being willing to leave it with me, I caused it to be set aside in a laboratory, where some furnaces kept the air constantly warm, and did there and elsewhere, at different times, look heedfully upon it, now and then displacing or quite taking off some of the thick scum that too much covered the surface of it, and by this means I had the opportunity to take notice of several phænomena, whereof these are the chief:—

1. I observed that the motion of this liquor was not only brisk, but very various, so that having loosened some small portions of the scum, one of them would be carried towards the right hand for instance, and another towards the left, at the same time. 2. Where the liquor first came out from under the scum, it seemed to move the most briskly, flowing almost like a stream whose motion upwards had been checked, and, as it were, reverberated by that incumbent obstacle. 3. Several motions in this liquor were the more easy to be observed, because, though it were dark, yet it was not uniform; consisting in part of oily and bituminous ingredients, which, though they seemed to have but one common superficies with the rest of the liquor, yet, but their colours and power of vigorously reflecting the light, they were easily enough distinguishable from the rest. And I often observed that some of these unctuous portions of the matter, emerging to the surface of the liquor, though perhaps at first one of them would not appear bigger than a pin's head, yet, in moving forwards, it would at the same time diffuse itself circularly, and make, as it were, a great halo, adorned with the colours of the rainbow, and so very vivid as afforded a very pleasant, and at first surprising, spectacle; these phantasms often nimbly succeeding one another, and lasting till they lost themselves against or under the thick scum. 4. The motions of this odd liquor were not only various, but frequently vortical; to be satisfied of which, I sometimes put short bits of straw, or fragments of some such like stuff, upon the discovered part of the surface of the liquor, by which they were carried towards very distant, if not opposite, parts of the vessel at the same time. But to make the vortical motion more evident, I several times detached considerably large pieces of the thick scum from the rest of the body, and had the pleasure to see them move both with a progressive motion in crooked lines, and with a motion about their own middlemost parts. All this while, the liquor, whose parts were thus briskly moved, was actually cold, as to sense. 5. To observe what the presence, or absence, of the free air would do to this liquor, I caused many spoonfuls of it, with some of the scum, to be put into a cylindrical glass, which, though large itself, had a neck belonging to it, that was but about the bigness of one's thumb, that it might be well stopped with a cork. But having, by this means, kept the

free air from having a full and immediate contact with the whole surface of the mixture, as it had when that mixture lay in the wide-mouthed vessel, I could not perceive the liquor to move to and fro, no, not though the orifice of the neck were left open: whereas, having, at the same time, poured some of the liquor into a very shallow and wide-mouthed vessel, called in the shops a clear-caked glass, it moved rather more than less nimbly and variously than in the great earthen pot (which yet was of the same shape), and shewed us many of those vivid and self-dilating circles that have been mentioned in the third number; and these, by the fineness of their colours and the quickness wherewith they succeeded one another, afforded a delightful spectacle as long as I stayed to observe the liquor. 6. Though the motions of the hitherto mentioned liquor did not seem to be always equally brisk, yet they appeared to continue manifest and various in some diversities of weather, as to cold and heat, and when I looked on it by candle-light as well as by daylight; and when, being not well enough to visit it myself, I sent one purposely to look upon it, about ten o'clock at night, he brought me word that it continued to move as formerly, and so it has done for ten days; and how much longer it will continue to do so, time must determine.

Postscript.—Some time after the foregoing account had been written, when I came to look upon the liquor (which in the mean time had been several times viewed, and appeared to retain its motions), I found, to my trouble, that somebody's impertinent curiosity and heedlessness had cracked the lower part of the earthen pot; at which overture, the liquor, though not the scum, was run out; which had put a period to our observations, but that, foreseeing that such an accident might happen, I had long before taken out some spoonfuls of the liquor, and kept it close stopped in a vial. By this means I had the opportunity to observe that, when I poured out the liquor into a wide-mouthed vessel, it would move as before, though this were done some weeks after it had been put up. And I remember that long after, having one day received the honour of a visit from a foreign minister, who was an inquisitive person and a man of letters, we chanced, among other things, to talk of the liquor; and though it were scarce to be hoped that it could still retain any of its motive virtue, yet, to gratify his curiosity, and that of some ingenious men

there present, I caused the vial to be brought, and having unstopped it, I poured out the liquor into a convenient-shaped vessel, in which, after we had suffered it to rest awhile, they were delightfully surprised to see it move (though not, in my opinion, quite so briskly as before), yet very manifestly and variously. This encouraged me to think it possible that it might retain some motion, though but languid, seven or eight weeks after; and therefore, on the 25th of July, I looked upon it again, and having caused it to be poured into a china cup, it manifested, at first, a brisk and various motion; but this, after awhile, did so slacken that I began to have some suspicion that the motion it was put into by effusion and the first contact of the air might have given it the greatest part of its agitation. But this being but suspicion, I put the vessel into divers postures in a window, the better to discover the true cause of this phænomenon; but whilst I was busy about this, which ingrossed my attention, a mischance overturned the cup, and, by throwing down the liquor, put an end to my speculation: yet this mischance hindered me but from observing how long the odd agitation of our liquor would have continued, but not from finding that it lasted a great while; for I shewed it the foreign minister about or after the beginning of June, that is, about five months or more after the liquor was first observed to move.*

The following is extracted from a letter of S. Hartlib to Mr. Boyle:—

I had lately received a letter from Mr. Oldenburg, amongst other particulars, in these words:—"In our passing through Mentz we met with a rare artist called Beckor, a young man, who hath found, he saith, the perpetual motion, the possibility whereof hath been hitherto so much disputed by philosophers. He hath almost finished a work, wherein he doth demonstrate his invention, which we have seen, and the design and way whereof the master told me himself, he would within a very few weeks put in print here at Francfort; which being done, I shall send you a copy of it.—July 18, 1658."†

* The Works of the Hon. Robt. Boyle, in 6 vols. 4to., 1772. Vol. 5, page 71.

† *Ibid.* Vol. 6, page 113.

The following eminent authority is often adduced in Encyclopædias; but his paper is little, if at all, known, entitled—" A Demonstration of the Impossibility of Perpetual Motion. By M. de la Hire. Written on the occasion of several schemes having recently appeared :"—

There is not any of those who pretend to have found out perpetual motion, who do not agree that two weights placed in a position to move, following their natural direction in equal time, or in any way reciprocal to their weight, remain in equilibrium. Yet there is no perpetual motion scheme, where one cannot draw a conclusion quite opposed to this principle; for, whatever may be pretended, perpetual motion is nothing more or less than the elevation of one weight to a certain height by the descent of another weight at the same time; and reciprocally the restitution of the first to the place where it was before its movement, by the descent of the one that had been raised, and so on *ad infinitum;* sometimes by means of weights, which, being raised, in their fall agitate other weights; sometimes by means of liquid bodies, which, being raised, can run, and move other parts far separated from the centre of motion; from which no advantage can be derived, and which is entirely contrary to the preceding principle.

Those who occupy themselves with this chimera, find nothing but embarrassment, for generally their machines have so many weights, &c., to move them, that their inventors forget always to be on their guard against the many hinderances that arise,—the height, &c., of the powers employed, their natural direction, &c., all these are sometimes so strangely jumbled together that it requires very hard work to be able rightly to distinguish them. This is one great reason that leads such persons to a false demonstration of perpetual motion; and when they propose their beautiful inventions to those who are versed in science, and who cannot immediately make them see or understand in what way their reasoning is false, they then publish to the world that the very cleverest men have been convinced of the truth of their perpetual motion.*

* Mémoires de l'Académie Royale des Sciences. Paris, 1730, 4to. Vol. 10, page 605. [See Appendix D.]

The Paris Academy of Sciences received numerous communications on Perpetual Motion, but in their "Comptes Rendus Hébdomadaries des Séances," in conformity with a regulation of long standing, they only name the authors and the matter of their papers when upon this subject, as—

Vol. 4, 1837.—A Letter from M. PASCAL, on perpetual motion.

Vol. 6, 1838.—M. Jennisson addressed a presumed solution of the problem of perpetual motion, offered by M. FREYBERG.

Vol. 13, 1841.—M. FURIET read a paper on perpetual motion, its object being to prove, by the most popular manner, its impossibility.

Vol. 14, 1841.—A communication received from M. VERGER on perpetual motion.

Vol. 29, 1849.—M. le Ministre de l'Instruction Publique transmits a note and paper addressed to him by M. le Prefet des Hautes-Pyrénées, in which the author, M. DULOT, describes a piece of mechanism by means of which he believes he obtains perpetual motion.

Vol. 38, 1854.—M. JAUFFRET announces himself as a candidate for the prize given for the improvement of navigation; he offers a propeller which he believes realizes perpetual motion.

M. THEOD. SYLVESTRE considers he has discovered perpetual motion.

M. BADANNEL begs the grant of a commission to examine a piece of mechanism he has invented, to give continued rotation and keep itself going.

The Academy, according to a regulation of ancient standing, cannot grant a commission to examine into papers relative to perpetual motion.

M. EUG. ROMEY announces his invention for showing the movements of the earth, acting also as a clock.

Vol. 39, 1854.—M. PARCEINT presents a paper and drawing of a propeller having a universal and continuous movement.

The Academy, as before, decline investigating this matter.

Vol. 40, 1855.—M. AIME LECOQ addresses a paper on perpetual motion to the Ministre du Commerce, &c., who

sends it to the Academy, and they refuse to grant a commission for the examination of communications relative to this subject, which they consider unattainable.

M. HUHN, of Prussia, announces having invented a system of aërial navigation, composed of a series of fanners, shaped like a bird's body, and the whole attached like a railway train. They are propelled by perpetual motion machinery.

As before stated, the Academy refuse accepting this and like offers.

Another note is addressed by M. RIEFFER on perpetual motion.

Vol. 41, 1855.—M. CASTAGNE addresses a letter relative to the squaring of the circle, and also on perpetual motion.

The Academy, as before, decline his offers, and state they consider all commucications on these two subjects null and void.

M. MUYTON writes a letter relative to perpetual motion.

The Academy, as before stated, decline to take the subject into consideration.

Vol. 42, 1856.—M. BLANCHET announces his intention of submitting to the judgment of the Academy a paper in which he considers he has resolved the question of perpetual motion.

The Academy, as in like cases, refuse any examination by a commission.

Vol. 43, 1856.—The Academy have received two notes on perpetual motion—one by M. PETREMENT, and the other by M. GRUSSET—which they refuse, on their former-named regulations.

Vol. 47, 1858.—A paper presented by M. le Ministre de l'Instruction Publique, enclosing two notes—one descriptive of an astronomical apparatus, and the other a piece of mechanism—showing perpetual motion. Both by M. VITELLI, a Neapolitan.

The Academy receive the first of these notes, but the second they reject.

M. MARCHAND sends a note on perpetual motion, which is refused, on the ground of their before-named decision.*

* Comptes Rendus Hébdomadaries des Séances, de l'Académie des Sciences. Paris, 4to.

In an abridgment of the Memoirs of the Royal Academy of Sciences at Paris, for 1700, an account is given of—

A false report of the Perpetual Motion being discovered, and the impossibility of it demonstrated.

There was in this year a report spread that the perpetual motion was found. It was seen in a place where the difficulty of the thing was not well known, where the invention was not examined as it would have been in an academy, where an air of science succeeds sometimes, and the air of confidence almost always. M. Sauveur explained the invention to the academy, who were very much surprised at it. A little while after the noise that this discovery made, the perpetual motion disappeared with its author. On this occasion, M. Parent proved the impossibility of it by this single reason, that all the parts of a machine have a common centre of gravity; that while they turn round an axis or fixed point, whichever it be, this common centre of gravity finds itself necessarily in one situation, where it is lower than in any other, and that presently all must stop. For, since there is a point where the force, which many bodies have to descend, is entirely re-united, as soon as this point cannot descend any more, all these bodies must remain fixed. M. Parent determined in general that there must inevitably be this point of rest for all the machines possible.*

* The Philosophical History and Memoirs of the Royal Academy of Paris; or, an Abridgment of all the Papers relating to Natural Philosophy. Translated and abridged by J. Martyn, F.R.S., and E. Chambers, F.R.S. 5 vols., 8vo. 1742. Vol. 1, p. 203.

CHAPTER V.

REMARKS ON PERPETUAL MOTION, DERIVED FROM TREATISES ON NATURAL PHILOSOPHY.

We here offer the opinions of Martin, 1747; Maclaurin, 1748; Rutherford, 1748; Hooper, 1783; Emerson, 1794; Nicholson, 1800; Young, 1807; Gregory, 1815; Partington, 1828; Arnott, 1828;—all authors easily accessible, and some or all of whom should be consulted before expending time or money on schemes which it is abundantly evident are constantly and shamefully terminating in disappointed hopes.

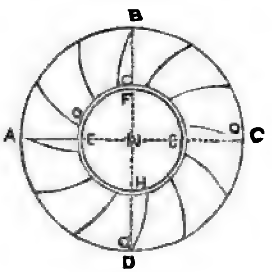
In his Lectures on Mechanics, Martin takes occasion to illustrate the impossibility of effecting Perpetual Motion, observing that—

A lever is any inflexible line, rod, or beam, moveable about or upon a fix'd point (called the prop or fulcrum), upon one end of which is the weight to be raised; at the other end is the power applied to raise it, as the hand, &c. Since (as we have before proved) the momentums of the weight and power are as the quantities of matter in each multiplied by their respective celerities, and the celerities are as the distances from the centre of motion, and also as the spaces pass'd through in a perpendicular direction in the same time, it must follow that there will be an equilibrium between the weight and power when they are to each other reciprocally as the distances from the centre, or as the celerities of the motions, or as the perpendicular ascent or descent in the same time; and this universally in all mechanical powers whatsoever, which is therefore the fundamental principle of all mechanics.

(XXXVII.) 1. The nature of this proposition being not

understood by smatterers in mechanics, gave occasion to imagine the possibility of a perpetual motion from one part of it, which they did not see was utterly impossible from another part of it.

2. That part which seem'd to promise the possibility thereof was this, viz., that the momenta of equal bodies were as their distances from the centre of motion. Hence, say the Perpetual Motion men, if a wheel were constructed of the form of that in the figure A B C D, with circular cells going from the inner part E F G H to the outer, containing equal balls C D E F; then upon turning the wheel they must move towards the centre N on one part, as the ball E; and from it on the opposite part, as the ball C; and by this means the ball C will have a greater momentum than the ball F, and so will determine the wheel to move round;



and since this must be the case of all the balls E and C that come into the situation E C, the wheel must necessarily move continually, because it will bring two balls into that situation.

3. 'Tis true, where there are but two balls E and C, the ball C would by this contrivance move the wheel one quarter round, viz., while it descended from C to D, and by this means would raise the ball E to F, and there they will abide in the situation D F. But, say the men of this persuasion, two other balls succeeding to the places E and C will keep the wheel moving. Yes, so they would, if the balls at D and E could be taken away the moment they come into that position,—not else; for the balls C and E, in order to move the wheel, must move the balls D and F, which have equal momenta (as being the same distance each from the centre as are the other two respectively), which is absurd by the general proposition.

4. The absurdity of a perpetual motion will still farther appear, if we consider that the momenta of bodies are always proportional to the perpendicular descent or ascent to or from the centre of the earth. Since, therefore, in the wheel the bodies are all equal by supposition, and the perpendicul spaces through which they descend and ascend, above and below the horizontal line or diameter A C, are equal, it

follows that an equilibrium must ensue. Thus, so far is this wheel from producing a perpetual motion, that it admits of none at all.*

Maclaurin, to the same purpose, treating of the Laws of Motion, and their general Corollaries, says:—

1. The first law of motion is, "That a body always perseveres in its state of rest, or of uniform motion in a right line, till by some external influence it be made to change its state." That a body of itself perseveres in its state of rest, is matter of most common and general observation, and is what suggests to us the passive nature of body; but that it likewise, of itself, perseveres in its state of motion as well as of rest, is not altogether so obvious, and was not understood for some time by philosophers themselves, when they demanded the cause of the continuation of motion. It is easy, however, to see that this last is as general and constant a law of nature as the first. Any motions we produce here on the earth soon languish, and at length vanish; whence it is a vulgar notion that, in general, motion diminishes and tends always toward rest. But this is owing to the various resistances which bodies here meet with in their motion, especially from friction, or their rubbing upon other bodies in their progress, by which their motion is chiefly consumed. For when, by any contrivance, this friction is much diminished, we always find that the motion continues for a long time. Thus, when the friction of the axis is lessened by friction wheels applied to it and turning round with it, the great wheel will sometimes continue to revolve for half an hour; and when a brass topp moves on a very small pivot on a glass plane, it will continue in motion very smoothly for a great number of minutes. A pendulum, suspended in an advantageous manner, will vibrate for a great while, notwithstanding the resistance of the air. Upon the whole, it appears that if the friction and other resistances could be taken quite away, the motions would be

* Philosophia Britannica; or, a New and Comprehensive System of the Newtonian Philosophy. By B. Martin. 2 vols. 1747. 8vo. (Vol. 1. Third Lecture on Mechanics. Pp. 106-8.) N.B.—Under "Perpetual Movement," the above is copied literally into "A New and Complete Dictionary of Arts and Sciences. By a Society of Gentlemen." 4 vols. 1754. 4to.

perpetual. But what sets this in the clearest light is, that a body placed on the deck or in the cabin of a ship continues there at rest while the motion of the ship remains uniform and steady; and the same holds of a body that is carried along in any space that has itself an uniform motion in a right line. For if a body in motion tended to rest, that which is in the cabin of a ship ought to fall back towards the stern; which would appear as surprising, when the motion of a ship is uniform and steady, as if the body should of itself move towards the stern when the ship is at rest. It is for this reason that the uniform motion of the earth upon its axis has no effect on the motion of bodies at the surface; that the motion of a ship carried away with a current is insensible to those in the ship, unless they have an opportunity to discover it by objects which they know to be fixed, as the shores and the bottom of the sea, or by astronomical observations; and that the motions of the planets and comets, in the free celestial spaces, require no new impulses to perpetuate them.*

[He then proceeds to consider the other laws of motion.]

And of the Mechanical Powers, he says:—

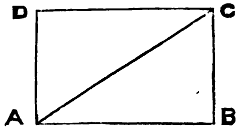
30. The mechanical powers, according to their different structure, serve for different purposes; and it is the business of the skilful mechanic to chuse them, or combine them, in the manner that may be best adapted to produce the effect required, by the power which he is possessed of, and at the least expence. The lever can be employed to raise weights a little way only, unless the engine itself be moved, as, for example, to raise stones out of their beds in quarries. But the axis and wheel may serve for raising weights from the greatest depths. The pullies being easily portable aboard ships, are therefore much employed in them. The wedge is excellent for separating the parts of bodies, and the screw for compressing or squeezing them together; and its great friction is even sometimes of use to preserve the effect already produced by it. The strength of the engine, and of its parts, must be proportioned to the effects which are to be produced by it. As we find that, when the centre of motion is placed between the power

* An Account of Sir Isaac Newton's Philosophical Discoveries, in four books By Colin Maclaurin, A.M. Third edition, 1775, 8vo. Page 118, chap. 2, book 2.

and the weight, it must sustain the sum of their efforts, a small balance ought not to be employed for weighing great weights, for these disorder its structure, and render it unfit for serving that purpose with accuracy; neither are great engines proper for producing small effects: the detail of which things must be left to the skilful and experienced mechanic.

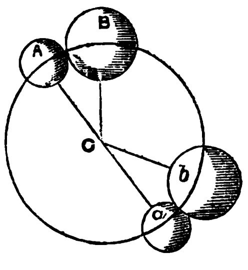
31. But besides the raising of weights and overcoming resistances, in mechanics we have often other objects in view. To make a regular movement, that may serve to measure the time as exactly as possible, is one of the most valuable problems in this science, and has been most successfully effected hitherto by adapting pendulums to clocks, tho' many ingenious contrivances have been invented to correct the irregularities of those movements that go by springs. Some have endeavoured to find a perpetual movement, but without success; and there is ground to think, from the principles of mechanics, that such a movement is impossible. In many cases, when bodies act upon each other, there is a gain of absolute motion; but this gain is always equal in opposite directions, and the quantity of direct motion is never increased. To make a perpetual movement, it appears necessary that a certain system of bodies, of a determined number and quantity, should move in a certain space for ever, and in a certain way and manner; and for this there must be a series of actions returning in a circle, to make the movement continual, so that any action by which the absolute quantity of force is increased, of which there are several sorts, must have its corresponding counter-action, by which that gain of force is destroyed, and the quantity of force restored to its first state. Thus, by these actions, there will never be any gain of direct force, to overcome the friction and the resistance of the medium. But every motion will be abated, by these resistances, of its just quantity; and the motions of all must at length languish and cease.

32. To illustrate this, it is allowed that by the resolution of force there is a gain or increase of the absolute quantity of force; as the two forces A B and A D (Fig. 2) taken together, exceed the force A C which is resolved into them. But you cannot proceed resolving motion



(*Fig.* 2 ;*tab.* 1.)

in infinitum, by any machine whatsoever; but those you have resolved must be again compounded, in order to make a continual movement, and the gain obtained by the resolution will be lost again by the composition. In like manner, if you suppose A and B (Fig. 42) to be perfectly elastic, and that the lesser body A strikes B quiescent, there will be an increase of the absolute quantity of force, because A will be reflected; but if you suppose them both to turn round any centre C, after the stroke, so as to meet again in *a* and *b*, this increase of force will be lost, and their motion will be reduced to its first quantity. Such a gain, therefore, of force as must be afterwards lost in the action of the bodies can never produce a perpetual movement. There are various ways, besides these, by which absolute force may be gained; but since there is always an equal gain in opposite directions, and no increase obtained in the same direction, in the circle of actions necessary to make a perpetual movement, this gain must be presently lost, and will not serve for the necessary expence of force employed in overcoming friction and the resistance of the medium.

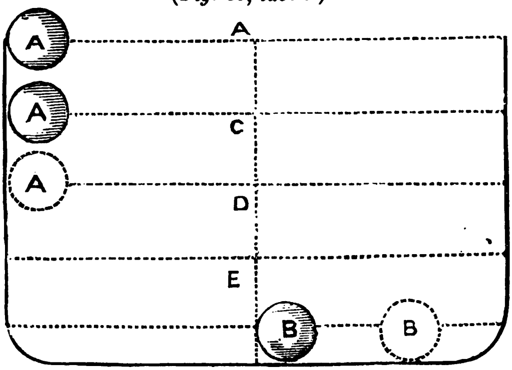


(*Fig.* 42, *tab.* 3.)

33. We are to observe, therefore, that tho' it could be shewn that in an infinite number of bodies, or in an infinite machine, there could be a gain of force for ever, and a motion continued to infinity, it does not therefore follow that a perpetual movement can be made. That which was proposed by Mr. Leibnitz, in August, 1690, in the Leipsic acts, as a consequence of the common estimation of the forces of bodies in motion, is of this kind, and, for this and other reasons, ought to be rejected. It is, however, necessary to add that, though on many accounts it appears preferable to measure the forces as well as motions of bodies by their velocities, and not by the squares of their velocities; yet, in order to produce a greater velocity in a body, the power or cause that is to generate it must be greater in a higher proportion than that velocity, because the action of the power upon the body depends upon their relative motion only; so that the whole action of the power is not employed

in producing motion in the body, but a considerable part of it in sustaining the power, so as to enable it to act upon the body and keep up with it. Thus the whole action of the wind is not employed in accelerating the motion of the ship, but only the excess of its velocity above that of the sail on which it acts, both being reduced to the same direction. When motion is produced in a body by springs, it is the last spring only which acts upon the body by contact, and the rest serve only to sustain it in its action; and hence a greater number of springs is requisite to produce a greater velocity in a given body than in proportion to that velocity. A double power, like that of gravity, will produce a double motion in the same time; and a double motion in an elastic body may produce a double motion in another of the same kind. But two equal successive impulses, acting on the same body, will not produce a motion in it double of what would be generated by the first impulse, because the second impulse has necessarily a less effect upon the body, which is already in motion, than the first impulse which acted upon it while at rest. In like manner, if there is a third and fourth impulse, the third will have less effect than the second, and the fourth less than the third. From this it appears what answer we are to make to a specious argument that is adduced

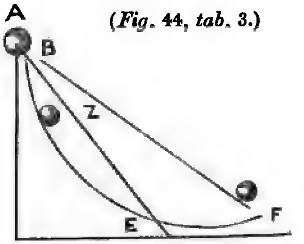
(*Fig.* 43, *tab.* 3.)



to show the possibility of a perpetual motion. Let the height A B (Fig. 43) be divided into four equal parts A B, C D,

D E, E B—suppose the body A to acquire by the descent A C, a velocity as 1, and this motion by any contrivance to be transmitted to an equal body B; then let the body A, by an equal descent C D, acquire another motion as 1, to be transmitted likewise to the same body B, which in this manner is supposed to acquire a motion as 2, that is sufficient to carry it upwards from B to A; and because there yet remain the motions which A acquires by the descents D E and E B, that may be sufficient to keep an engine in motion, while B and A ascend and descend by turns, it is hence concluded that a sufficient gain of force may be obtained in this manner, so as to produce a perpetual movement. But it appears, from what has been shewn, that a motion as 2 cannot be produced in B by the two successive impulses transmitted from A, each of which is as 1.

Some authors have proposed projects for producing a perpetual movement, with a design to refute them; but, by mistaking the proper answer, have rather confirmed the unskilful in their groundless expectations. An instance of this we have in Dr. Wilkins's "Mathematical Magick," book 2, chap. 13. A loadstone at A (Fig. 44) is supposed to have a sufficient force to bring up a heavy body along the plane F A, from F to B; whence the body is supposed to descend by its gravity, along the curve B E F, continually. But supposing B Z E to be the surface upon which, if a body was placed, the attraction of the loadstone and the gravity of the body would balance each other, this surface shall meet B E F at some point E between A and F, and the body must stop in descending along A E F at the point E.*



(Fig. 44, tab. 3.)

* An Account of Sir Isaac Newton's Philosophical Discoveries, in four books. By Colin Maclaurin, M.A. Published from the author's MS. papers, by Patrick Murdoch, M.A. and F.R.S. Third edition, 8vo. 1775. Book 2, chap. 3, p. 187. N.B.—First edition, 4to., printed 1748.

The foregoing article may be found copied into "A New and Complete Dictionary of Arts and Sciences. By a Society of Gentlemen." 4 vols. 4to. 1754.

Dr. Rutherford, in allusion to Perpetual Motion, says:—

98. The friction of the parts of a machine against each other will in time destroy any motion that has been communicated to it.

Amongst the other mutual actions of bodies upon each other, we reckon friction. No machine can have the surface of its parts made exactly smooth by polishing, though their roughness may be made too small for our eyes to discover it. And as a body by striking directly upon another, that is either at rest or in motion, will lose velocity, so, as the parts of a machine rub against each other, when the prominence of one part, though ever so small, strikes upon the prominence of another part, the motion of the parts will by this means be diminished, and by frequent strokes of the same sort will in time be entirely destroyed.

From hence it follows that no machine can be so contrived as to have a perpetual motion, or always to preserve the motion once impressed upon it; for the motion communicated will by the friction of the machine be constantly decreasing, and must end at last.

To prevent this, in all the contrivances for a perpetual motion the usual attempt has been to find out a way of repairing the motion which is lost by friction; and as bodies move themselves by the force of gravity, and as motion is likewise generated by the spring of such bodies as are elastic, the way of repairing the motion as it decays by friction must be by the application of one or other of these two properties of matter. The motion of some clocks is kept up by the force of gravity; but then this motion is not a perpetual one, for the clock stops as soon as the weights are down. Other clocks are kept in motion by elastic springs; but this motion ceases likewise, when the spring, by having expanded itself, is grown too weak to repair it any longer. And indeed, neither of these properties can be so applied as to make a perpetual motion. This I will endeavour to shew, from one or two of the principal contrivances in the two following propositions:—

99. The force of gravity cannot produce a perpetual motion.

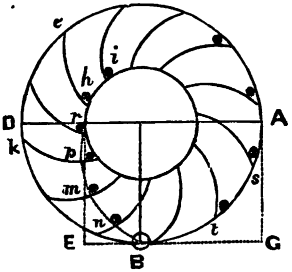
The general reason for this has been already given; for, since gravity produces motion in bodies only whilst they can

descend, the motion of a machine, which is lost by the friction of its parts, can be repaired by a weight no longer than till the weight is down, or is come to the ground, and is prevented by it from descending any longer.

In order to remove this difficulty, machines have been contrived with more weights than one, of which some are to be constantly ascending whilst the others are descending. Where we may observe that the descending weights are applyed to two purposes; they are to repair the motion in the machine, and likewise to raise the other weights which were down as low as they could go; and these weights, when they are raised, are to descend again, and in their turn to answer the same purpose. For this end, some one or more of the mechanical powers is made use of, by the assistance of which the descending weights may be made to move always with a greater velocity than the ascending ones; and then, if the quantities of matter in the weights be equal, their moments will be as their velocities, and consequently the descending weights may by this means have a moment given them so much greater than the ascending ones have as to be sufficient to answer the two purposes already mentioned.

It would be endless to examine all the inventions of this sort. The principle upon which they depend is applyed in the neatest manner in the wheel described by Desaguliers; and by examining the principle in this one instance, we shall see the fallacy of it, and how little hopes of success there is in any other application of it. The wheel (Fig. 1, plate 4) has two rims or circumferences, D *e* A B and *r h i f*. The space between the two rims is divided into cells by the spokes *q* A, *f t*, *p* D, *h e*, &c., which are bent in such a manner as to cause weights placed loose in the cells to descend on the side A *s t* B from A to B, which is the lowest point, on the outer rim of the wheel, and to ascend again from B on the other side of the wheel B D, in the line B *n m p r*, which comes nearer the centre C and touches the inner rim. Thus the weights

(*Fig.* 1, *pl.* 4.)



on the descending side of the wheel being farther from the centre of motion than those on the ascending side, it is imagined that the moment of the former will always be greater than the moment of the latter. The weight A, in particular, descends to B in the arc A *s t* B, which is a quarter of a circle; but it rises from B to D in the curve B *n m p r*, which is less than a quarter of a circle. And, since the velocity is as the space described in a given time, the velocity and consequently the moment of A when it descends is greater than its moment when it ascends. This will be the case of every weight in its turn; therefore, the descending weights will always have a greater moment than the ascending ones.

The fallacy is this:—The velocity with which the weight A descends to B is estimated by the line A *s t* B, whereas the velocity of all bodies in motion is to be estimated in the line of their direction, by the second law of motion. For it is only in the line of direction that any force acts so as to communicate motion to a body; and it is in the same line only that the body in motion acts, when it communicates motion and is itself considered as a moving force. From hence it follows, that the velocity with which a weight descends, if the weight is considered as a moving force, must be estimated in the line of its direction, that is, in a line drawn from its centre of gravity to the centre of the earth; or, the velocity of a weight is proportional to the approach of it in any given time to the earth's centre. In like manner, the velocity with which the weight ascends is to be estimated in the line of its direction, and in any given time it is as the distance to which it is raised from the earth's centre in that time. From hence it appears that, though the weight A descends to B in the curve A *s t* B, yet the velocity with which it descends being as its approach to the earth's centre, is as A G = C B; and though the same weight ascends in the lesser curve B *n m p r*, yet the velocity with which it ascends being as the distance to which it is raised from the earth's centre in that time, is as E *r* = C B = A G. Therefore, the descending and ascending velocities are equal, and consequently the moment of the descending weights will be no greater than the ascending ones.

I do not know whether this will be made more intelligible by distinguishing between the weight's velocity whilst it

descends and the velocity with which it descends. This may appear to the reader too nice a distinction; but I hope he will understand my meaning, if he observes that whilst A descends it does not move directly downwards in the line A G, but moves partly downwards and partly in a horizontal direction, and by both these motions together is carried to B. Since, therefore, whilst it descends it is likewise carryed horizontally, I think it is evident that it does not descend with its whole velocity; therefore, its velocity whilst it descends is different from the velocity with which it descends, as different as the whole is from its part. Or otherwise, whilst A descends to B in the line A *s t* B, we may consider its motion as resolved into the two sides of a parallelogram, A G and A C = G B; where the velocity with which it descends is A G, and the other part of its velocity A C or G B carries it horizontally. In like manner we may distinguish between the velocity which the weight has whilst it ascends and the velocity with which it ascends; for if, as before, the weight ascends in the curve B *n m p r*, we may consider its motion as resolved into the two sides of a parallelogram, B C = E *r* and B E; where the velocity with which it ascends is E *r*, and the other part of its velocity B E carries it horizontally. Now, the descending velocity A G is equal to the ascending velocity E *r;* and, therefore, the moment with which the weight descends will be equal to the moment with which it ascends. The horizontal velocity G B of the descending weight is greater, indeed, than the horizontal velocity B E of the ascending one. But I suppose it is unnecessary to prove that this cannot possibly contribute anything towards turning the wheel, or towards making the moment on the descending side greater than the moment on the ascending side; for I imagine the reader will easily see that a motion in the direction G B E or A C *r* will not contribute in the least towards making the point A descend, or towards turning the line A C D round upon the centre of motion.

100. The force of elasticity cannot produce a perpetual motion.

Elastic springs, as has been observed already, by expanding themselves grow weak; and, when they are quite expanded, become entirely unable to produce any motion at all. But in proposition 83 it was shown that if an elastic ball A strikes upon another B, which is greater than itself,

the moment of B after the stroke will be greater than that of A was before it. In like manner, if B was to strike upon C, another elastic body greater than itself, the motion might still be increased. And thus, by placing more elastic bodies in the row, of which each should be greater than the last before it, the motion might be increased in what proportion we pleased. Now, why might not motion produced in this manner be applied to repair what is lost in a machine by the friction of its parts, and to make the motion of the machine a perpetual one? I intended to supply the reader with an answer to this question when I desired him to remember in the instance of two bodies, in proposition 83, that though there is motion produced if we consider the greater body alone, yet if both bodies are taken together there is no motion produced in the same direction; but the moment in the same direction is exactly the same after the stroke that it was before it. This would be the case were there ever so many bodies. But a machine can only be moved by moving forces in the same direction; for equal moving forces in contrary directions would destroy each other and produce no effect on the machine, and the effect produced by unequal ones in contrary directions will be as their difference. Since, therefore, the moving force, by which the motion of the machine should be repaired, is the moment of these elastic bodies, and since their moment in the same direction is the same after the stroke that it was before; it follows, that no such moment is produced by the stroke as can keep the motion of the machine and make it perpetual. For instance, suppose the machine consists of four wheels; call them *c*, *d*, *e*, and *f*. Let *c* be the first mover, and let *f* be the last. Now, if *c* begins to move with 8 degrees of moment, and by the friction 2 degrees are lost when the motion comes to the wheel *f*, then *f* can return only 6 degrees of motion on *c*, the first mover. And thus the motion, as it decays in every round, will at last be entirely lost, unless some method could be found for repairing it. Suppose, therefore, that there were two elastic balls A and B, and that A is to B as 2 to 4; then, by proposition 83, if A strikes B with a moment 6, B will gain by the stroke a moment 8. Now, if *f*, the last wheel which has only the moment 6, was to strike upon A, and A to strike upon B, and B to strike upon the first wheel *c*, then this first mover would have the same motion 8 communicated to it, with which it

began to move. And as the two elastic bodies would always repair the 2 degrees of motion that are lost by friction in conveying the motion from *c* to *f*, why might not this contrivance be so applyed as to make the machine a perpetual motion? I answer, because, though B strikes *c* with 8 degrees of motion, yet A will at the same time be reflected with 2 degrees against *f*, and striking *f*, the last mover, by reflection, will stop the machine with a force 2, whilst B is moving it with a force 8. Therefore, by the action of both bodies together, of B impelling *c* with the moment 8, and of A reflected back upon *f* with the moment 2, the machine will be moved only with the difference, or $8-2=6$. So that if *c* began to move at first with the moment 8, and this moment by being carried round through *d* and *e* to *f* was reduced to 6, the two elastic balls A and B will not repair the moment lost; but the machine will have only 6 degrees of moment, notwithstanding the seeming increase of motion by A's striking upon B.*

Dr. Hooper describes "A Clock to go perpetually by the influence of the Celestial Bodies," and very properly discriminates the difference between such action and a self-motive power. He says:—

The construction of the movements in this clock is the same with those in common use; it differs from those only in its situation and the manner in which it is wound up.

This clock is to be placed near a wall, by or against which the tide constantly flows. To each of the barrels round which the string that carries the weight is wound, there must hang a bucket, and into that, when the tide rises to a certain height, the water runs, by means of a pipe fixed in the wall. The bucket then overbalancing the weight, descends, and winds up the clock; but when it comes to a certain depth, it is taken by a catch fixed in the wall, which by turning it over discharges the water; the weights of the clock then descend in the usual manner, and the buckets are drawn up.

Now, as this clock is kept in motion by the tide, and as

* A System of Natural Philosophy. By T. Rutherford, D.D., F.R.S. 2 vols. 4to., 1748. Vol. 1, pp. 88-92.

the tide proceeds from the influence of the sun and moon, it necessarily follows that the motion of the clock proceeds from the same cause, and that as long as the parts of the machine remain, motion will be perpetual.

This, according to the common acceptation of the term, is certainly a perpetual motion, and so is every mill that is driven by a constant stream; but that is not the sense in which the term was used by the advocates for a perpetual motion in the last century. They meant a machine which, being once put in motion, should, by its peculiar construction, move perpetually without any fresh force impressed. This they attempted by various means : as the attraction of a load-stone, the descent of heavy bodies, the difference of the momentum in revolving weights, &c., all of which, though ingenious enough, discover a want of due attention to the principles of mechanics. Besides, if a perpetual movement could be effected by either of those means, it would be of very little or no use : for the unavoidable wear of the several parts of the machine, arising from the incessant friction, must necessarily destroy that equality of motion which alone could render its perpetuity of any consequence.*

Emerson, in Prop. CXVIII., treating how "To determine the friction and other irregularities in mechanical engines," says :—

6. As to the mechanic powers. The single leaver makes no resistance by friction. But if, by the motion of the leaver in lifting, the fulcrum or support be changed further from the weight, the power will be decreased thereby.

7. If any wheel of a machine running upon an axis, the friction on the axis is as the weight upon it, the diameter of the axis, and the angular velocity. This sort of friction is but small.

8. In the pulley, if $p\ q$ be two weights, and q the greater, and if $W=\frac{4\,p\,q}{p\times q}$, then W is the weight upon the axis of the single pulley. And it is not increased by the acceleration of the weight q, but remains always the same.

* Rational Recreations. By W. Hooper, M.D. 4 vols. 8vo. 1783. Vol. 1, p. 187; recreation 55.

The friction of the pulley is very considerable when the sheaves rub against the blocks, and by the wearing of the holes and axles.

The friction on the axis of the pulley is as the weight W, its angular velocity the diameter of the axis directly and the diameter of the pulley inversely. A power of 100lbs. with the addition of 50lbs. will but draw up 500lbs. with a tackle of 5.

And 15lbs. over a single pulley will draw up only 14lbs.

9. In the screw there is a great deal of friction. Those with sharp threads have more friction than those with square threads, and endless screws have more than either. Screws with a square thread raise a weight with more ease than those with a sharp thread.

In the common screw the friction is so great, that it will sustain the weight in a position given when the power is taken off. And, therefore, the friction is at least equal to the power. From whence it will follow, that in the screw the power must be to the weight or resistance, at least as twice the perpendicular height of a thread to the circumference described by one revolution of the power, if it be able to raise the weight, or only sustain it. This friction of the screw is of great use, as it serves to keep the weight in any given position.

10. In the wedge the friction is at least equal to the power, as it retains any position it is driven into. Therefore, in the wedge the power must be to the weight at least as twice the base to the height, to overcome any resistance.

11. To find the friction of any engine, begin at the power, and consider the velocity and the weight at the first rubbing part, and estimate its quantity of friction by some of the foregoing articles; then proceed to the next rubbing part, and do the same for it; and so on through the whole.

And note, something more is to be allowed for increase of friction by every new addition to the power.

Cor.—Hence will appear the difficulty, or, rather, impossibility of a perpetual motion, or such a motion as is to continue the same for ever, or at least as long as the materials will last, that compose moving machines.

For such a motion as this ought continually to return undiminished, notwithstanding any resistance it meets with, which is impossible. For, although any body once put into motion,

and moving freely without any resistance, or any external retarding force acting upon it, would for ever retain that motion, yet, in fact, we are certain that no body or machine can move at all without some degree of friction and resistance; and, therefore, it must follow that, from the resistance of the medium, and the friction of the parts of the machine upon one another, its motion will gradually decay, till, at last, all the motion is destroyed, and the machine is at rest. Nor can this be otherwise, except some new active force, equal to all its resistance, adds a new motion to it. But that cannot be from the body or machine itself; for then the body would move itself, or be the cause of its own motion, which is absurd.*

Among the numerous communications made by William Nicholson to the journal he conducted, and which bears his name, he contributed the following carefully-written paper—"Concerning those Perpetual Motions which are producible in Machines by the Rise and Fall of the Barometer or the Thermometrical Variations in the Dimensions of Bodies:"—

In a former communication, I have given an account of some of the delusive projects for obtaining a perpetual motion from an invariable power.† In that paper, I remarked that the flow of rivers, the vicissitudes of tides, the variations of winds, the thermometrical expansions of solids and fluids, the rise and fall of the mercury in the barometer, the hygrometric changes in organised remains, and every other of those mutations which never fail to take place around us, may be applied as first movers to mills, clocks, and other engines, and keep them going till worn out. Many instances of this kind of perpetual motion are seen in water-mills and other common engines, which are necessarily confined to certain local situations. The windmill, though less confined with respect to place, is the subject of a much more variable power; other instruments, still less confined with regard to situation and exposure, have been made, which are capable of

* The Principles of Mechanics. By W. Emerson. 4to. 1794. Fourth edition, p. 173.

† Philosophical Journal, vol. 1, p. 375.

continuing their motion without ceasing. Such was the clock, or perpetual motion, in Cox's Museum, which was shewn about twenty years ago in London. My former paper was written to shew the value of the perpetual motion, strictly so called, which has for the most part been pursued by men of little information. In the present memoir, I shall endeavour to ascertain that of this second kind of motion, which, because more promising, and of nearly the same practical value, has been followed at some expense by men of higher claims. For this purpose, I shall first describe a few schemes, and then investigate the quantity of power they are likely to afford.

Fig. 1, plate 6, is a sketch of the first mover in a clock which formed part of Cox's Museum, which was sold by public lottery, about the year 1776, if my recollection be accurate. A represents the surface of the mercury in a barometer, the glass vessel of which had the form of a bottle or chemical mattrass. The diameter of the upper surface of the mercury was, I think, about twelve inches. C D represents the bason, or receptacle, into which the aperture of A B was plunged. I suppose, of course, that the lower surface of mercury, which was exposed to the pressure of the atmosphere, was nearly the same as the upper, A B, as, in fact, it appeared to be. From the intervention of the case, and other parts of the apparatus, I could only conjecture the manner in which the effect was produced; but this was afterwards explained to me by Mr. Rehe,* who contrived and made it. The bason B D is suspended by two chains K L, which pass over the pullies or wheels H I, and are attached to the frame E F, which last is fixed to the barometer A B. Let us now suppose the apparatus to be at liberty, and it will be clearly seen, that if the two masses attached to the opposite ends of the chains K L be not precisely equal, the heaviest will descend, and cause the lightest to rise. The masses must, therefore, be brought nearly to this state of equality, by the adjustment of weight added to one or both of them. In this state, suppose the pressure of the atmosphere to increase, and the consequence will be, that a portion of the mercury, being forced from the vessel C D into A B, will

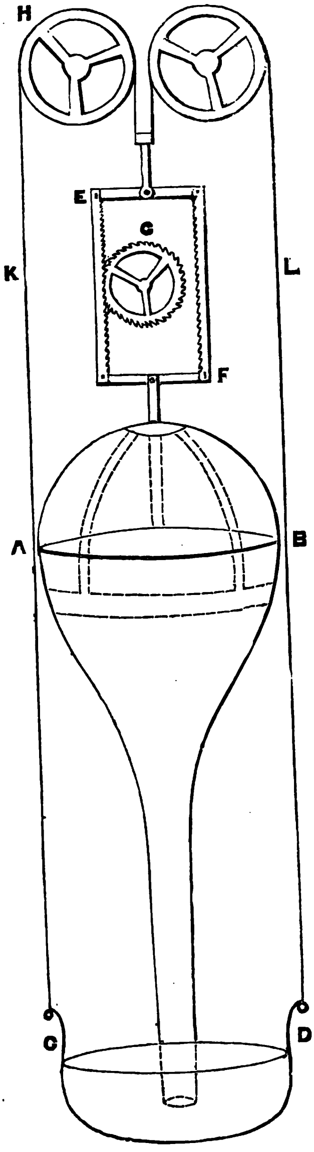
* This gentleman is at present one of the Board of Inspection of Naval Works at the Admiralty. June, 1799.

render this last heavier, and cause it to descend, while C D at the same time rises. And, on the other hand, when, by a diminished pressure of the external air, the mercury subsides in A B, the vessel C D will preponderate, and A B will rise. Now, the frame E F, which is interposed between the barometer and the pullies I K, is jointed at the corners, and also at the places where it is attached to the chain and the barometer; and the inner edges of the upright pieces E F are formed into teeth, like those of a saw, the slopes of which lie in opposite directions, as is shewn in the figure. The wheel G, which is placed between these bars, is also toothed in the same manner; and its diameter is such, that when the teeth on each side, as, for example, E, are engaged, those on the other side, F, may be free; but it is too large to admit of both sides being disengaged at once. The wheel G is prevented, by a click, from moving in the direction opposite to that which may be produced by the action of the bars E and F. Hence, the play of the machine is evident. When the pressure of the atmosphere diminishes, and the barometer rises from its cistern, the side E of the frame will move the wheel G through a greater or less space, according to the variation; and when, on the contrary, it falls, the teeth E will be drawn out of their bearing, and those of F will be thrown into the wheel, and still produce a motion of the same kind; the joints of the frame E F allowing it to change its figure enough for this purpose. It is hardly necessary to remark that this wheel G, being connected with the clock, serves to wind it up, and that the clock is constructed to go for a much greater number of days than the barometer has ever been known to remain stationary.

The ingenious mechanic will readily form a notion of many other methods of applying the variations of the barometer to similar objects. The wheel-barometer of Robert Hook, as well as another contrivance, in which the barometer and its cistern are placed at the different extremities of an inclined lever, may likewise be used for this purpose.

Several artists have exerted their industry in attempts to apply the variations produced by change of temperature in bodies as a first mover. If a thermometer be suspended by its centre of gravity in such a manner that the tube may lie nearly horizontal, the daily variations in the bulk of the mercury will cause a preponderance on the one side or the other,

(*Fig.* 1, *pl.* 6.)



accordingly as the temperature is higher or lower than it was at the original fixing of the centre of suspension. The thermometer may contain mercury or any other fluid, or it may consist of air confined by mercury, as in the manometer. In this contrivance, the great and frequent ranges of variation afford much promise of utility. The limits of convenient or practicable power from change of equilibrium in a fluid thermometer will hereafter be examined. A much greater force seems to offer itself in the power by which the expansion is produced; but the difficulty of forming a piston or other apparatus for confining fluids, will probably constitute an insurmountable impediment to this method.

The solid thermometer does not present the same difficulty. Fig. 2 represents a series of expansion-bars, each consisting of a plate of brass, soldered to another of steel, and possessing the property of bending by change of temperature, according to the laws already explained in this work.* If the steel face of C A be uppermost, and the end C be fixed to C B, the extremity A will rise from B when the temperature is elevated; and if the succeeding bars be similarly fixed above each other, as in the figure, the whole system will occupy a greater length, or elevation, above C B, when heated, than when cold. Another more convenient method of disposing the bars is shewn in Fig. 3. In this, the bars are fixed together at the middle, with the brass faces turned towards each other. Each bar has a slight curvature (much less than is here shewn), which will be increased by heat, and by that means cause the distance between the middle of two extreme bars to be greater than it would be at a lower temperature.

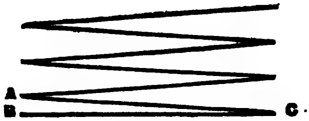
These causes of action may be applied to machinery by various contrivances, some of which serve to increase the length of range, but add nothing to the power. This last, no doubt, is an object of convenience, according to the effect intended to be produced. The only method of adding to the power will consist in increasing the number of the bars. Fig. 4 represents a system for this purpose, which is the simplest and most convenient that has occurred to me. A C represents the circumference of a barrel, resembling those in which the mainsprings of clocks are put, the length and diameter of which may be varied, according to the power

* Philosophical Journal, vol. 1. pp. 62, 576.

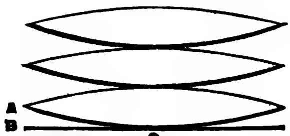
intended to be gained. To this external part is fixed a ratchet-wheel, to receive the click C, which confines its motion to one direction. At A is fixed a plate, to receive the action of the expansion-pieces. B D is an internal cylinder of the same kind, which is also confined, by a ratchet-wheel and click, to move only in the same direction as the outer part A C. It is not necessary to describe the operative arrangements by which these two cylinders are disposed so as to move on the same axis, and the ends duly applied, so as to form one box, while the interior and exterior parts are allowed to move independent of each other. At B is fixed a plate, by which the action of the expansion-pieces is communicated to the inner cylinder. A series of bars, similar to those delineated in Fig. 3, are disposed in the space between the two cylinders, the greatest part of which they occupy, leaving only such an interval between A and B as may be sufficient to allow for the motion of the bars. In this interval is placed a spring, tending to cause A and B to recede from each other; and, lastly, there are side-pins proceeding from the places of friction of every pair of bars, which respectively pass through circular grooves in the caps, and prevent the motion of the bars from being interrupted or impeded by their touching either the inner or the outer cylinders. E represents a wheel, which is supposed to be connected, by tooth-work or otherwise, with the face of the external cylinder, and may be considered as the machinery intended to be moved. Or otherwise, if the clicks C and D, with the teeth they act upon, be reversed, and the interior cylinder be fixed to the axis itself, that axis may be used as the first mover.

Suppose this apparatus to be put together at a certain temperature in the day-time, and that in the night the temperature becomes colder, in this case, the curvature of all the bars will diminish, and the distance between A and B will be increased by the action of the intermediate spring; but as the plate A is prevented by the click C from receding, the plate B will be pushed forward, and the interior cylinder will gather a certain number of its teeth upon the click D. The next day, when the temperature again rises, all the expansion-bars will bend, and the space between A and B will be diminished; this, however, cannot happen by the motion of B, which is held fast by the click D. The external part will, consequently, be now carried forward, and will act upon the

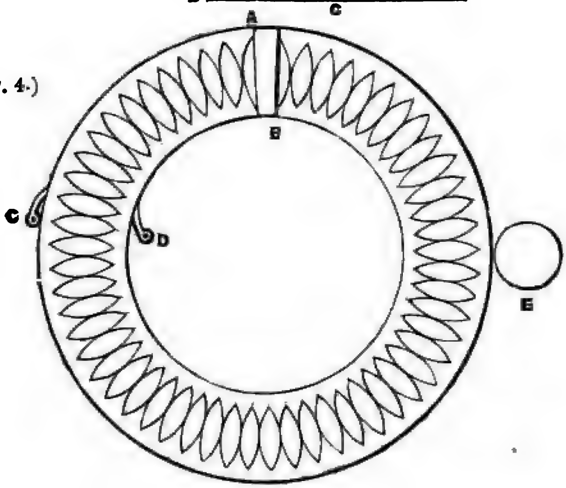
(*Fig*. 2.)



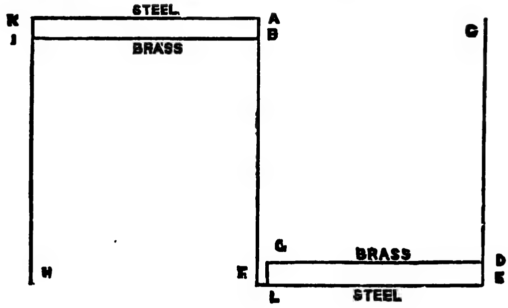
(*Fig*. 3.)



(*Fig*. 4.)



(*Fig*. 5.)



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apparatus E. A second lowering of the temperature, by whatever cause, will occasion the interior part again to advance, and, in this manner, the accumulations of force may be incessantly reiterated.

Experience must determine how far the properties of these compound bars may be changed in the course of time.* It seems probable that the mere changes communicated by the atmosphere could scarcely produce any sensible effect; and whether this effect would be detrimental to the general result, may also be questioned. Considerations of this nature lead to the enquiry, whether our object may not, with equal facility, be obtained by the direct push or pull of bars of metal, as in the gridiron pendulum, or that of Ellicott.†

If a succession of bars of brass were disposed round a cylindrical face of less expansible metal, so as to form an helical line from the one end to the other; or, otherwise, if we suppose a brass clock chain, with a right-lined edge, to be wrapped round such a cylinder; or, again, if, instead of the cylinder, we suppose the chain to pass over a succession of rollers, whether disposed in a cylindrical system or according to the form of a pulley, the result will be the same; that is to say, the chain will contract and expand about the ten-thousandth part of its length, for every ten degrees of Fahrenheit's thermometer. In the way of rough estimate, let us, therefore, assume a cylinder of cast-iron, one foot in diameter and one foot in length, having a groove turned in its surface, like a screw, with twelve turns in the inch, for the purpose of lodging a system of friction rollers to receive the brass chain, wrapped round it. Such a chain,‡ consisting of 144 turns, would measure 450 feet,§ and would contract nearly 0.54 inches for every 10 degrees, or one-twentieth of an inch for each degree of change of temperature; but as the cylinder itself contracts, the whole effect will be somewhat less than half that quantity; that is to say, each degree of the thermometer will be one-fortieth of an inch.

The philosophical world is aware that hygrometers have

* Philosophical Journal, vol. 1, p. 62.

† *Ibid.*, pp. 59, 60.

‡ And would cost about £25.

§ For pyrometrical data, see Philosophical Journal, vol. 1, p. 58.

been made, on this principle, with catgut, hair, whalebone, and other materials. It seems probable that the first of these would exert considerable force as a first-mover, but it would scarcely prove durable; and, what is still worse, the variations of moisture in the atmosphere are little suited to operate upon machinery preserved in a case in an apartment.

If the increase of the space moved through by the expansion of metals, upon the principle of Ellicott's pendulum, should be adopted instead of the compound bars in Fig. 4, the project of Fig. 5 may be followed. A bar of steel A K is fixed beside a bar of brass B I, the joinings I K being inflexible; but those at A B, in the lever A F, being jointed, the difference of expansion between the two metals will be magnified at F, in the proportion of A F to A B. The lines L C G D E represent a second combination of the same kind, in which the point G will have a similar and equal motion to that of F; but the bar E L being prolonged to F, so as to bear upon the lever E F, the whole of the second combination will be pushed forward by the expansion of the first, on account of which, the motion of G will, in fact, be double that of F; by the addition of a third combination, the motion will be tripled, &c. A sufficient number of these, properly placed in the cavity between the two cylinders, Fig. 4, would afford the same consequences; but it may be doubted whether any contrivance of this last kind could afford the same power in as small a space as that occupied by the compound bars.

I shall now proceed to form an estimate of the quantities of force communicated by these several contrivances.

The apparatus (Fig. 1, plate 6), or barometrical clock, is driven by a force which may be estimated in its annual quantity from the sum of the deviations of the barometer taken from a meteorological journal, such as that in the Philosophical Transactions; together with the quantity of mercury so moved, which may be derived from the dimensions of the surfaces in the tube and basin. From these variations, severally, must be taken the quantity of what mechanics call lost time, or the ineffectual movement between the direct and retrograde actions on the machinery. The whole power will be measured by the entire column of variation, supposed to descend through half its height; for this will be the case when a perpendicular tube empties itself by the descent of any fluid contained in it. I have not taken

the trouble to collect these elements; but it may easily be imagined that the sum of all the variations during the year would amount to no great quantity. I understand, from the ingenious constructor of this apparatus, that the accumulated power was not sufficient to allow the clock to be maintained by a force equal to that which drives a common watch, namely, six ounces, with the daily fall of twelve inches.

In the investigation of the power of expansion, in Fig. 4, a variety of curious objects of physical and mathematical research offer themselves to our consideration. In a former part of this journal,* it has been shewn that the curvature assumed by a straight compound bar, having each of its parts uniformly thick, will be circular; whence it follows, from the nature of versed sines of small arcs, that the distance A B, Fig. 2, will, *cæteris paribus*, be as the square of C A; and it should seem as if a considerable advantage might be derived from using the whole length of the bar, as in that figure (2), instead of the two half-lengths in Fig. 3. But it must be considered that the effect of hammer-hardening the lower part, and wire-drawing the upper, of the compound bar C A, is twice as great at C, Fig. 2, as it is at C in Fig. 3, and is shewn in the greater spring or yielding of the parts, and that the action at A, in this figure, is doubled at the opposite extremity of the bar; so that, upon the whole, the action at A, on account of the short lever A C, Fig. 3, being twice as powerful as that at A in Fig. 2, and being exerted through the space A B, Fig. 3, of one-fourth part of the space A B in Fig. 2, will be half the action at the end of Fig. 2. But as both extremities of the bar are made to act in Fig. 3, the whole of its action will be precisely equal to that in Fig. 2. The combination, Fig. 3, appears, therefore, to be preferable on account of its convenient figure only.

It may also be questioned whether these bars should be made extremely thin or the contrary. If they be very thin, the effect of the reaction being equivalent to a pull or push endways upon the bar, which is greater than the reaction itself, in the proportion of the length of the bar to its half thickness, it may easily be imagined that the texture and cohesion will be most strongly affected; but, on the contrary, if the bar be very thick, the effect from change of tempera-

* Vol. 1, p. 62.

ture may resolve itself entirely into an action upon the parts near the contiguous surfaces, without producing any flexure at all. It appears, therefore, that there is a thickness which is practically better than any other; but what this thickness may be, remains to be determined by trials. As the quantity of motion is inversely as the thickness (Philos. Journal, i., 576), and the force directly as that thickness, it must follow that the quantity of mechanic effect in all similar bars, neither extremely thick nor extremely thin, will be the same upon equal changes of temperature. I should give the preference to thin bars, not so much reduced as to have any perceptible spring.

If the Fig. 4 be supposed of such dimensions as that the circular arc struck through the middle parts of all the bars might be three feet in length, and the bars were each six inches long in the radial direction, with a thickness nearly equal to that of the second experiment related at the last-quoted article of our journal, the space moved through by each bar, upon an alteration of 146 degrees, would be about 0.05 inch, or half a tenth; but 300 of these bars might with ease be contained in the circular space of three feet; and these would produce a motion of fifteen inches by the same change of temperature, or one-tenth of an inch for every degree of Fahrenheit. In order to determine the force with which this change of position would be effected, we are in want of some experiments on the expansions of metals. It is generally supposed that a rod or wire will contract or dilate by change of temperature in the same manner, whether it be at perfect liberty to move horizontally, or be made to support a weight hung from its extremity, or placed on its upper end. This is, in fact, supposed to be the case in the estimates for constructing gridiron pendulums; and if it were strictly true, the power of this wheel would be constantly equal to the reaction against which it should be exerted. But it would be to little purpose to institute a calculation upon data assumed at random. I shall therefore only remark that the power of this wheel is very considerable, and may be increased almost at pleasure, by enlarging the dimensions of the bars in the direction parallel to the axis of the cylinder.

Whatever question there may be with regard to the force and durability of this system of bars—neither of which I am disposed to doubt—there can be scarcely any with regard to

the spiral chain round the cylinder. The direct expansion and contraction of metals is certainly very powerful, and was shewn in a striking manner by the Rev. Mr. Jones, in an experiment related, if my memory be correct, in George Adam's Philosophical Lectures. He hung a very heavy weight to the longer end of a lever, the shorter arm of which pressed upwards against the longer arm of another lever, and the shorter arm of this last was supported by a rod of metal. By this mechanical arrangement, it will be understood, without difficulty, that a very slight motion of the arm which bore upon the metal might be attended with a very considerable motion of that extremity which supported the weight; and the dimensions were such, that this was in fact the case.

The flame of a candle applied to the bar of metal caused it to expand, and carried up the load without difficulty.

Hygrometric contractions and dilations are known to be performed with immense force; but want of durability in the materials, and the difficulty with regard to exposure, which has been already mentioned, seem to forbid the practical use of this power for the purpose to which our attention is now directed.

The contrivance, Fig. 5, may be considered as effectual; but the objections which have been made to Ellicott's pendulum are still more strongly applicable to this, namely, that the friction, the wear, and the irregular action of the joints, must be hurtful to the general effect.*

In Nicholson's Journal, vol. 1, for 1802, page 27, is given the "Construction of an hydraulic apparatus, which by means of the syphon raises water above its level, and performs its alterations without attendance." It is the invention of "William Close." It has pipes and valves which require nice adjustment, it is stated, "to prevent the sudden pressure of the atmosphere from forcing the air out of the empty pipes with such rapidity as would [and no doubt did] destroy the operation of the syphon." The article is not of sufficient interest to extract *in extenso*.

* A Journal of Natural Philosophy, Chemistry, and the Arts. By William Nicholson. Vol. 3, pp. 126 and 172. 1800. 4to.

A New Project for Perpetual Motion. In a Letter from R. B. to Mr. Nicholson.

Sir,—I was much gratified, several years ago, by some essays with which you obliged your readers upon the perpetual motion. In the first volume, p. 375, of your quarto series, I find an account of several schemes (necessarily abortive) for producing perpetual motions by the action of gravity; and in your third volume I find an account of various methods of keeping up the motion of a machine by means of the changes which take place in the barometer and thermometer. I have ventured to send you the sketch of a project for a perpetual motion of the latter kind, which has long remained among my memorandums. You will see it is not of the class of perpetual motions, properly speaking, but merely the application of some existing intermittent motions in nature to the purpose of maintaining the rotation of machinery.

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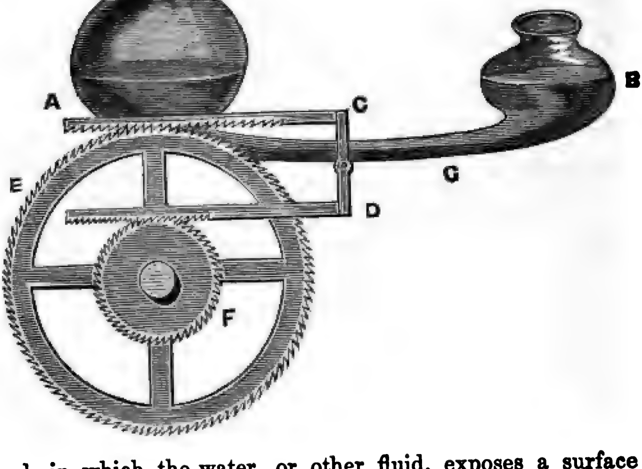
Fig. 1, plate 12.—A represents the marine barometer of Halley, but varied by the addition of a vessel B at the open

(*Fig.* 1, *pl.* 12, *vol.* 9.)



end, in which the water, or other fluid, exposes a surface nearly equal to that in the closed vessel A. These two

vessels are connected by a long horizontal tube G. It is evident that any change, either in the pressure of the external air or the elasticity of the internal air, will cause the fluid to run along the tube, and add to the weight of A or of B, according to circumstances. The heavier vessel will preponderate, but it will be prevented from descending too far by a stop or bearing to which it will arrive. Any change in the inclination of G will move the attached lever C D; by means of which, one of the two horizontal racks will be made to push round that ratchet-wheel into which its teeth fall, at the same time that the other rack will be drawn backwards upon its wheel. The opposite action will drive forward the other wheel; and, as both these wheels are fixed on the same axis, the system will be driven the same way by every change of density or weight in the air that takes place.*

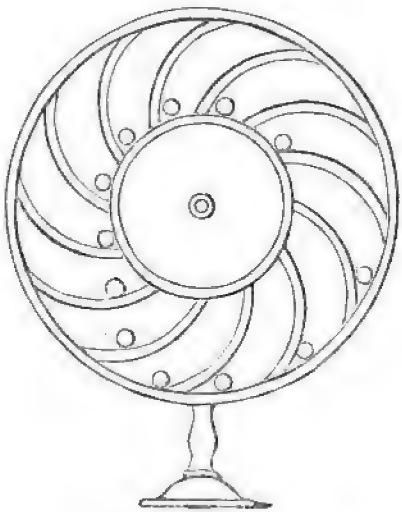
Dr. Young, in his ninth lecture "On the Motions of Connected Bodies," remarks:—

To seek for a source of motion in the construction of a machine betrays a gross ignorance of the principles on which all machines operate. The only interest that we can take in the projects which have been tried for procuring a perpetual motion must arise from the opportunity that they afford us to observe the weakness of human reason, to see a man spending whole years in the pursuit of an object which a week's application to sober philosophy might have convinced him was unattainable. The most satisfactory confutation of the notion of the possibility of a perpetual motion is derived from the consideration of the properties of the centre of gravity. We have only to examine whether it will begin to descend or to ascend when the machine moves, or whether it will remain at rest. If it be so placed that it must either remain at rest or ascend, it is clear, from the laws of equilibrium, that no motion from gravitation can take place; if it may descend, it must either continue to descend for ever, with a finite velocity, which is impossible, or it must first descend and then ascend with a vibratory motion, and then the case will be reducible to that of a pendulum, where it is obvious that no new motion is generated, and that the friction and resistance of the air

* A Journal of Natural Philosophy, Chemistry, and the Arts. By Wm. Nicholson. Vol. 9, p. 212. 1804. 8vo.

must soon destroy the original motion. One of the most common fallacies, by which the superficial projectors of machines for obtaining a perpetual motion have been deluded, has arisen from imagining that any number of weights ascending by a certain path on one side of the centre of motion and descending on the other at a greater distance, must cause a constant preponderance on the side of the descent: for this purpose, the weights have either been fixed on hinges which allow them to fall over at a certain point, so as to become more distant from the centre, or made to slide or roll along grooves or planes which lead them to a more remote part of the wheel, from whence they return as they ascend; but it will appear, on the inspection of such a machine, that although some of the weights are more distant from the centre than others, yet there is always a proportionally smaller number of them on that side on which they have the greatest power, so that these circumstances precisely counterbalance each other. (Fig. 78, pl. 6, page 91.)

(*Fig.* 78, *pl.* 6.)



Note on plate 6, page 763, vol. 1:—

Fig. 78.—A wheel supposed to be capable of producing a

perpetual motion; the descending balls acting at a greater distance from the centre, but being fewer in number than the ascending. In the model, the balls may be kept in their places by a plate of glass covering the wheel. (Page 92.)*

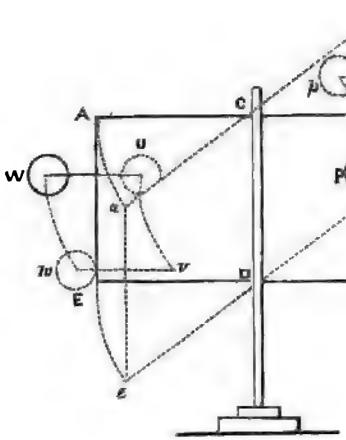
The following occurs in a Scholium at page 82 of Dr. Gregory's "Treatise of Mechanics:"—

Before we close our discussion respecting the lever, it may not be amiss just to remark, that in every attempt to determine the advantage gained by this machine peculiar attention must be paid, not only to the directions in which the forces are exerted, but to the points on the lever to which their action is to be referred. Without a due regard to these particulars, the mechanist will often be involved in error, even in simple cases where there might be supposed but little probability of mistake. In fact, even the simple property of the straight lever, that equal weights acting at equal distances from the fulcrum on opposite sides will be in equilibrio, while at unequal distances the one which acts most remotely from the fulcrum will preponderate, has more than once been a source of error in unskilful hands; and in particular, it has lain at the foundation of most of those ill-fated and useless contrivances which have been struck out by such as were in pursuit of the perpetual motion. In these contrivances the object of the projector has generally been to apply different weights to a rotatory machine in such manner that, at successive moments of time, first one and then another should be brought to greater distances from the centre, and so, by being placed at the extremity of a longer lever, should produce a constant motion. To prevent, therefore, such waste of time and ingenuity, we shall here describe an apparatus invented by Dr. Desaguliers (see Phil. Trans., No. 419, or New Abridg., vol. 6, p. 542), in which two equal weights may be placed at any unequal distance whatever from the centre of motion, and still remain in equilibrio. In Fig. 3, pl. 5, A B represents a balance with equal arms, and E F another of equal dimensions: they turn freely upon the centres C D, and their extremities are connected by equal

* A Course of Lectures on Natural Philosophy. By Thomas Young, M.D. 2 vols. 4to. 1807.

inflexible bars A E, B F; the whole being permitted to move freely at the points A B C D, so as to assume the forms of varying parallelograms, in consequence of any motion upon

(*Fig.* 3, *pl.* 5.)



the points C and D. Across the bars A E, B F, are fixed others, as W U, P Q, from any points of which equal weights, P W, may be suspended. Now, on whatsoever part of the bar P Q the weight P is fixed, it is manifest that it will, on account of that bar being firmly connected with the vertical rod B F, act as though it were placed at F; and, in like manner, in whatever part of the bar W U the weight W be suspended, it will act as though it were placed at E: so that, however great may be the difference of the distances of the bodies P and W from C D, they will still, if equal in weight, balance each other in any position of the system. Nor is this in any respect incompatible with the principle of the equal products of weight and velocity, which we have mentioned (130) as a useful indication of an equilibrium; for, suppose this compound balance to be brought by motion on its centres into the position *a b c d*, the weights being then at *w* and *p*, those weights will have moved through the arcs W*w*, P*p*, while the extremities of the levers will have passed through the equal and respectively parallel arcs A*a*, E*e*, B*b*,

F*f*; of consequence, the velocities of the two weights will have been equal, as they ought to be, in conformity with that principle. Thus, then, it appears, from this simple contrivance, that weights do not preponderate in machines merely on account of their different distances from the centre of motion; and, consequently, a mere increase of distance does not universally give a mechanical advantage.

[The paragraph 130, before alluded to, occurs at page 71, as follows :—]

130. Writers on the subject of mechanics have often attempted to demonstrate the properties of the several simple machines by means of a celebrated theorem, which is this: When two heavy bodies counterpoise each other by means of any machine, and are then made to move together, the products of each mass into its velocity, or, as it is technically expressed, the quantities of motion with which one body descends and the other ascends perpendicularly, will be equal. Since an equilibrium always accompanies this equality of motions, it bears such a resemblance to the case wherein two moving bodies stop each other when they meet together with equal quantities of motion, that many have thought that the cause of an equilibrium in the several machines might be immediately assigned by saying that, because one body always loses as much motion as it communicates to another, two heavy bodies counteracting each other must continue at rest when they are so circumstanced that one cannot descend without causing the other to ascend at the same time, and with velocities inversely proportional to their masses; for then, should one of them begin to descend, it must instantly lose its whole motion by communicating it to the other. But this argument, however plausible it may seem, is (as Dr. Hamilton remarked) by no means satisfactory; for when we say that one body communicates its motion to another, we must necessarily suppose the motion to exist first in the one and then in the other; but in the present case, where the two bodies are so connected that one cannot possibly begin to move before the other, the descending body cannot be said to communicate its motion to the other, and thereby make it ascend; but whatever we should suppose causes one body to descend, must also be the immediate cause of the other's ascending, since, from the connection of the bodies, it must

act upon them both together, as if they were really but one. And therefore, without contradicting the laws of motion, we might suppose the superior weight of the heavy body, which is in itself more than able to sustain the lighter, would overcome the lighter, and cause it to ascend with the same quantity of motion with which the heavier descends; especially as both their motions, taken together, may be less than what the difference of the weights, which is here supposed to be the moving force, would be able to produce in a body falling freely. For these reasons, and various others which might easily be assigned, we are of opinion that all proofs founded upon this theorem as a basis are necessarily unsatisfactory: we have, nevertheless, thought it right to notice it; and, as it may serve as a good index of an equilibrium in many machines, and admits in some instances of a useful application, we may again refer to it in the practical part of this treatise.*

In treating "Of Friction," Millington says:—

From a number of experiments that have been made to investigate the power of friction, it appears to increase in a less ratio than that of the weight of the moving body, although this conclusion is contrary to the generally-received opinion, and has a limit; for if the moving surface be too small or too thin to support its own weight, it will not bear evenly, and will wear into a groove or notch which may occasion much additional friction.

However perfectly a piece of machinery may be made, still friction, to a certain degree, must ever exist, and cannot be prevented. It follows, therefore, that the power that is given to one extreme of a machine can never be conveyed without abatement to the other; and hence it will immediately appear that a perpetual motion is impossible, because this presumes that a certain power is to be communicated to a machine, and is to be transferred through all its different movements from the beginning to the end of the machine, when it must be given back again without diminution, in order that it may be communicated back again to the beginning of the machine to

* A Treatise of Mechanics. By Olinthus Gregory, LL.D., &c. 2 vols. 8vo. Third edition, 1815. (Vol. 1, pp. 71 and 82.)

produce a repetition of the same impulse it had produced in the first instance, otherwise the motion of the machine could not be maintained. But since no effect can be produced that is greater than its cause, and as the cause must be diminished by friction, *vis inertiæ*, &c., in its transfer through a machine, so it cannot be renewed with a power equal to that with which it began; consequently, a perpetual motion must be considered as an unattainable thing, inasmuch as it implies a renewal of power which no machine can give to itself.*

In his "Manual," Partington describes, as follows, a well-known galvanic apparatus maintaining long-continued motion:—

Mr. Singer contrived an arrangement (of M. De Luc's electrical column or dry pile) which is well calculated to form a perpetual motion, by excluding, to a very considerable extent, the operation of extraneous causes of interruption; and it at the same time renders the disposition of the apparatus rather elegant. A series of from 1,200 to 1,600 groups are arranged in two columns of equal length, which are separately insulated in a vertical position by glass pillars constructed on his principle of insulation; the positive end of one column is placed lowest, and the negative end of the other; and their upper extremities being connected by a wire, they may be considered as one continuous column. A small bell is situated between each extremity of the column and its insulating support, and a brass ball is suspended by a thin thread of raw silk, so as to hang midway between the bells, and at a very little distance from each of them. For this purpose, the bells are connected, during the adjustment of the pendulum, by a wire, that their attraction may not interfere with it; and, when the wire is removed, the motion of the pendulum commences. The apparatus is placed upon a circular mahogany base, in which a groove is turned to receive the lower edge of a glass shade, with which the whole is covered.†

* An Epitome of the Elementary Principles of Natural and Experimental Philosophy. 1 vol. 8vo. 1823. Page 85.

† A Manual of Natural and Experimental Philosophy. By Charles F. Partington. 8vo. 1828. Vol. 2, p. 206.

Dr. Arnott, in his "Elements of Physics," section 2 of the first part, on "Motions and Forces," says:—

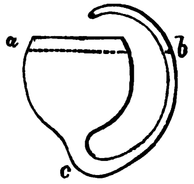
Further illustrative of the truths that action and reaction are equal and contrary, and that in every case of hard bodies striking each other, they may be regarded as compressing a very small strong spring between them, we may mention that when any elastic body, as a billiard ball, strikes another larger than itself, and rebounds, it gives to that other, not only all the motion which it originally possessed, but an additional quantity, equal to that with which it recoils, owing to the equal action in both directions of the repulsion or spring which causes the recoil. When the difference of size between the bodies is very great, the returning velocity of the smaller is nearly as great as its advancing motion was, and it gives a momentum to the body struck, nearly double of what it originally itself possessed. This phenomenon constitutes the paradoxical case of an effect being greater than its cause, and has led persons imperfectly acquainted with the subject to seek from the principle a *perpetuum mobile.* (Page 109.)

The following reflections occur at page 141, part 2, "Mechanics:"—

What an infinity of vain schemes—some of them displaying great ingenuity—for perpetual motions, and new mechanical engines of power, &c., would have been checked at once, had the great truth been generally understood, that no form or combination of machinery ever did or ever can increase, in the slightest degree, the quantity of power applied. Ignorance of this is the hinge on which most of the dreams of mechanical projectors have turned. No year passes, even now, in which many patents are not taken out for such supposed discoveries; and the deluded individuals, after selling perhaps even their household goods to obtain the means of securing the supposed advantages, often sink in despair, when their attempts, instead of bringing riches and happiness to their families, end in disappointment and utter ruin. The frequency and eagerness and obstinacy with which even talented individuals, owing to their imperfect knowledge of this part of natural philosophy, have engaged in such undertakings, is a remarkable phenomenon in human nature.

In section 1 of the third part, treating on "Hydrostatics," he says :—

A projector thought that the vessel of his contrivance, represented here, was to solve the renowned problem of the perpetual motion.* It was goblet-shaped, lessening gradually towards the bottom until it became a tube, bent upwards at *c*, and pointing with an open extremity into the goblet again. He reasoned thus: A pint of water in the goblet *a* must more than counterbalance an ounce which the tube *b* will contain, and must therefore be constantly pushing the ounce forward into the vessel again at *a*, and keeping up a stream or circulation, which will cease only when the water dries up. He was confounded when a trial shewed him the same level in *a* and in *b*.†



In Montucla's admirable "Histoire des Mathematiques," completed by J. de la Lande, and published in 4 vols., 4to., 1802, no less than eight pages are devoted to a dissertation (here briefly translated) as follows :—

On perpetual motion—a chimera old and celebrated enough in mechanics for us to treat of it in this work. It is understood to be a movement which continually preserves and renews itself without exterior help. Many real discoveries have been the result of this enquiry. Montucla's "Mathematical Recreations" and the "Journal des Savans," 1678 to 1745, treat on this subject. Several machines have been made, intended to solve this knotty problem, and made much noise in the scientific world, but have all proved failures; and it is now more an insult than praise to say any one is

* A contrivance on precisely the same principle here enunciated, was proposed by the Abbe de la Roque, in "Le Journal des Sçavans, Paris, 1686. The instrument was a U tube, one leg longer than the other and bent over, so that any liquid might drop into the top end of the short leg, which he proposed to be made of wax, and the long one of iron. Presuming the liquid to be more condensed in the metal than the wax tube, it would flow from the end into the wax tube, and so continue. Page 29.

† Elements of Physics, or Natural Philosophy. By Neil Arnott, M.D. Third edition, 1828. Page 270.

M

searching after perpetual motion. Among all the known properties of matter and motion, there does not appear among them one single principle that would give the intended effect. It is allowed that action and reaction must be equal. Friction and the air also retard motion. Neither can any machine receive greater motive power than that which is first communicated to it. And perpetual motion cannot take place unless the power communicated be much greater than the generating power, and unless it compensates for the diminution of power caused by friction, which is impossible. Thus the question is reduced to finding a weight heavier than itself, or an elastic power greater than itself. Thus it is requisite to find some method by which a combination of mechanical power will gain a strength equivalent to that which is lost; it is principally this last point that is sought, to resolve the problem. It is certain that the multiplication of powers serves no purpose, as whatever is gained in power is lost in time, so that the quantity of motion remains the same. One small power can never be mechanically made really equal to a greater one.

Maupertius, in his letters on different scientific subjects, remarks that atmospheric changes, &c., are excluded, and that inertia, &c., are alone made subservient to obtaining perpetual motion, which he considers unattainable. Inertia and elasticity are also inapplicable.

In 1700, a report was current that perpetual motion had been found. Sauveur explained it to the Academy of Sciences, and Parent proved its impossibility.

In the philosophical works of 's Gravesande, published at Amsterdam, 1774, is an account of a machine constructed by Orffyreus in 1715. It was called the Wheel of Cassel, and is described in a letter to Newton. Gravesande is persuaded that it can be shown that perpetual motion is not a contradiction; and it appears to him that Leibnitz was wrong in regarding as an axiom the impossibility of this movement. It caused general surprise that this great man should try to prove its possibility, and expressing a hope that the prejudices of mathematicians regarding this movement would not prevent their giving serious attention to the subject. Jean Bernoulli also believes in the success of Orffyreus's discovery. (See Opera, tome i., page 41.)

Wolf, in 1716, in his "Dictionary of Mathematics," gives

the arguments of Sturm, Lorini, Stévin, and Leibnitz, against perpetual motion. He considers there is a doubt whether the movement in Orffyreus's machine was not the effect of some invisible fluid.

The examination that 's Gravesande made of Orffyreus's wheel so aggravated him that he broke the machine the same day, as may be seen in the "Annal. Physico-Med. de Breslaw," Leipzig, 1723, page 427. Also, in his life, 's Gravesande states that Orffyreus wrote on the wall that it was the impertinent curiosity of the professor which caused him to break it. This seems to indicate that he feared an ulterior examination; but 's Gravesande has never confessed that he himself was deceived. At the same period appeared D. G. Diez's dissertation against perpetual motion, and he names De Lanis, Drebbel, Becher, and Mitz, all as chimeras.

Peresc and Kepler were incredulous on this subject, the first wrote 1691 and the latter 1607 (published 1718).

Baron de Zach has made some very curious researches in respect to different inventions for perpetual motion, in "Reichs-Anzeiger," 1796. In conclusion, there is a lecture on perpetual motion, by Henrich., 1770.

In 1775, the Royal Academy of Sciences in Paris passed the resolution not to examine any machines announced as intended for perpetual motion, and gave their motives for so doing in the History of the Academy, 1775, page 65.

[See Appendix E.]

CHAPTER VI.

PAPERS FROM EARLY SCIENTIFIC AND OTHER JOURNALS.

THE "Gentleman's Magazine" and "Annual Registers" afford several interesting communications; some from each were necessarily transferred to Chapter II. We have here, also, the "Monthly Magazine" of 1806-19; "Annals of Philosophy," 1820; and "Royal Institution," 1802.

The following are from the "Gentleman's Magazine:"—

I.—Two "Schemes for the Discovery of the Longitude."

Two persons—one at Exeter, the other at Dublin—conceive they have made some discoveries towards finding out the important secret of the longitude.

The Irish gentleman declares he has made several trials with good success, after a plain, easy, intelligent way, by machines of his own invention, which have given him an entire confidence of the truth of their operation; but not having opportunity to try the experiment at sea in different kinds of weather, wherein he has not the least doubt of success, he invites the assistance of some publick-spirited gentleman to fit out a ship two or three months for that purpose; on which consideration he will communicate the secret, and assign over half the reward.

The Exonian (who, by the way, signs himself "The Farmer," because he had wrote something formerly under that name) is more explicit, and gives the following account of his scheme:—

Discovery of a Perpetual Motion, whereby the Longitude may be mechanically found.

Before I proceed to this simple, yet most useful, discovery, I shall premise a few necessary things, viz.:—

1. That the difference of time is the difference of longitude,

because every 15 degrees to the eastward of any meridian is an hour sooner, and every 15 degrees to the westward is an hour later, in time, than at the said meridian; since 24 times 15 degrees compose the 360 degrees of the earth's circumference.

2. Hence it must follow, that if any vessel revolve round the globe westward, a day will be gain'd when that revolution is perform'd; and if she make her revolution eastward, a day must be lost, since by how much she departs from her meridian to the eastward, by just so much she loses; because every 15 degrees that way is one hour earlier in time; the 360 degrees in this eastern circuit must be 24 hours earlier, and consequently that time must be lost by a well-regulated perpetual motion, and the contrary.

3. It is generally allow'd, that the perpetual motion being found, this would discover the longitude; which I also grant, but with this provision, that it is so nicely regulated as to keep time exactly with or without an equation-table; that is to say, equal time to correspond with the sun.

4. Yet, as I prefer such a perpetual motion as will keep pace with apparent time, or, in other words, with the sun's shadow on a dial, or a true meridian line, being discover'd stands in no need of any equation-table at all; so I shall evidently make it appear that such a motion is found, in a proper sense for our purpose. So that what has hitherto been thought impossible by the generality of mankind shall no longer be a secret. And,

5. It must be granted, when duly consider'd, that there are many movements which, in the sense foregoing, may be call'd perpetual; yet, hitherto, there never came under my observation any of them that could be depended on in the case before us, except that one which I shall discover.

6. I will instance in two particulars, that are easily framed, tho' not very common.

First, There are some spring clocks and watches, so contriv'd by art as to lose no time in winding, by having a spring fixed to stand free from the work, except at such times as they are to be wound up; but then, by pulling a string fasten'd to it for that end, this spring presses sufficiently on a tooth in the main wheel to keep the movement going, so that no time is lost in winding. And this, I say, in a proper sense to the purpose, may be call'd perpetual; yet none of them

can be so sufficiently adjusted as to keep time to exactness, therefore not to be depended on in this case.

Secondly, Our long pendulum clocks, which are by the same contrivance kept going while wound, may be said, in the same sense, to be perpetual in their motion; yet even these, tho' nearer the truth than the other, are not to be depended on in a matter of so great moment. Nor, indeed, is there any equation-table extant that is just, even Flamstead's correct table being about 15 minutes erroneous at one time of the year, tho' it is right in October, when his greatest difference comes to 16 min. 2 sec.

Having thus premised, my next business shall be to demonstrate a perpetual motion, that comes so near the truth as not to vary from apparent time (tho' that is very unequal) 3 min. in a whole year, tho' daily proved by a dial well set, or by a just meridian line; which I take to be the greatest discovery hitherto so publickly made manifest.

But in order thereto, and to carry instruction with me to a mean capacity, I must have recourse to the method whereby so wonder-working a machine was first framed, by the late most ingenious Joseph Williamson, watch-maker, in London, whose name there is famous, and his works greatly admired.

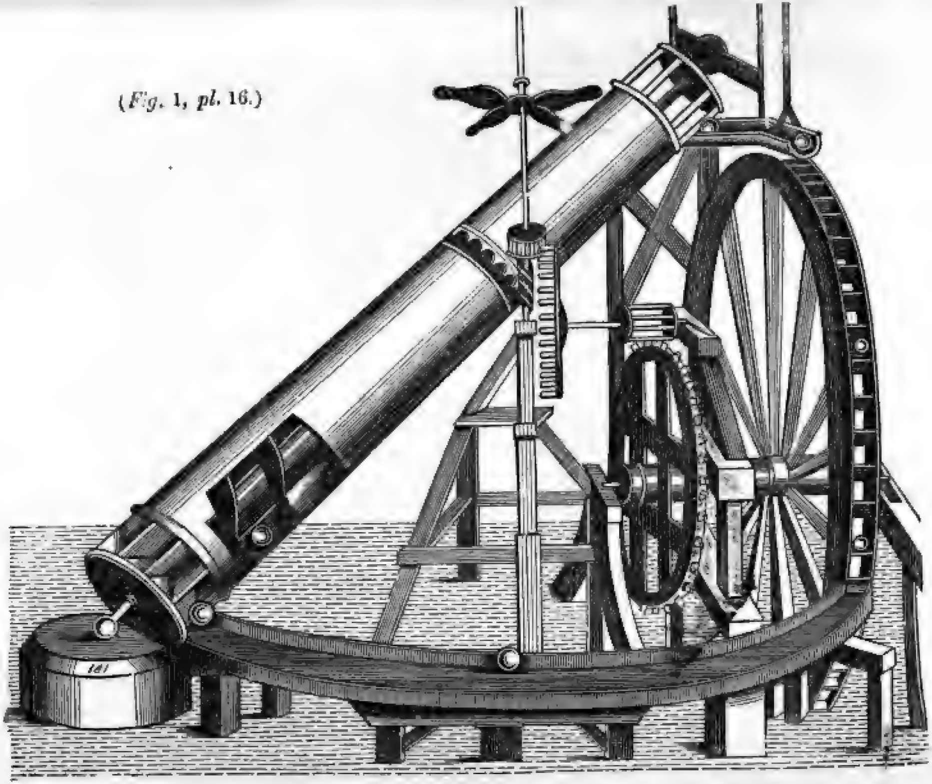
[He then explains how this horologist, from "his thirst after the knowledge of equation," spent seven years in forming correct tables.]

From this true equation-table, this excellent workman formed an elliptical wheel, that revolved once a year, and so fixed it to the day of the month, that it had such influence on the pendulum, by shortening and lengthening it, that his clocks, thus framed, would keep time to admiration with the sun, and therefore he called them his sun-clocks. This is the perpetual motion I commend to the world, for it loses no time at all in winding.

[This last expression shows how much it partook of a real perpetual motion. He goes on to state the praise bestowed on the invention in "a speech made to the Royal Society by Sir Isaac Newton." After this, follow observations on its uses, the mode of fixing it on board ship, with several necessary precautions.]

And so curious is the invention, that the spring which keeps the work going while the clock is wound up is also fixed to a plate that always by its force slides back again to

(*Fig.* 1, *pl.* 16.)



close the holes that receive the key for that end, when the tooth of the main wheel has, in its course, slipt from it.

* * * * * *

I subscribe,

THE FARMER.

P.S.—Nothing hitherto found can be so regularly adjusted to the time as a long pendulum movement. All springs are fallible, and short pendulums too. But those of about 33 inches long, that beat true seconds, are next to infallibility, being kept in perpetual motion, as I here manifest they may be.*

II.—Raising water:—Fig. 1, Col. Kranach's machine for constant motion, with a power to raise water. Fig. 2, Mr. Gervas's engine for raising water.

EXPLANATION.

Fig. 1 represents an artificial machine for constant motion; the inventor is Col. Kranach, who, in a book printed at Hamburgh, asserts that when once put in motion for any of the following works, it will continue its operation both night and day without any other help or assistance except that of a small quantity of standing water: that by it large and heavy weights may be drawn up, to 2,000 weight; that in 24 hours it will fling out 2,400 barrels of water, and is therefore highly necessary for the draining of land overflown by inundations; that it will be of great use in mines to draw up the water and ore 24 fathoms deep; that it may be employed instead of wind or water mills, for all manner of uses; and that this machine may be put either in a quick or slow motion.

The author protests that he had laboured for thirty years together before he brought this machine to perfection, and declares his readiness to oblige any gentleman with a small or large model thereof, and to inspect the building of it for use, at a reasonable gratification.

* Vol. 7, 1737, p. 67.

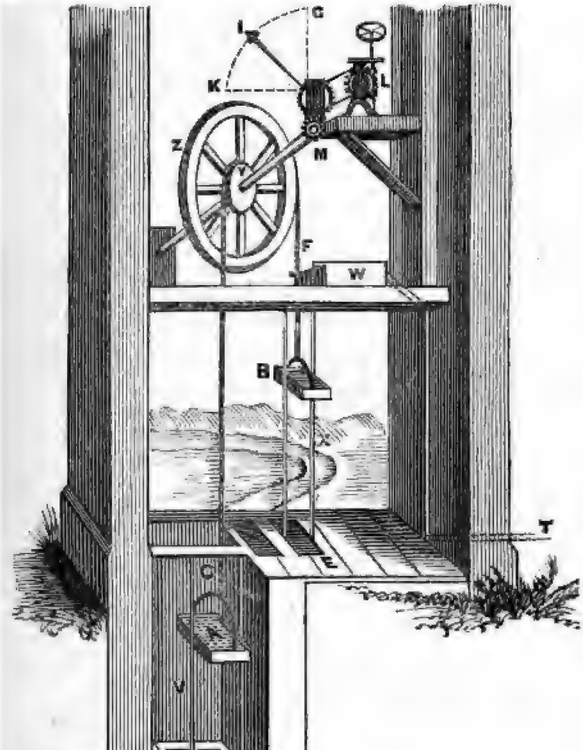
Fig. 2.—This is a representation of an engine for raising water, like that erected by Mr. Gervas, at Sir John Chester's, near Newport Pagnel.

A and B are two copper buckets of an unequal weight and size, suspended by chains, which alternately wind off and on the multiplying wheel Y Z; the part Y being smaller in diameter, and Z larger, in proportion to the different lift for which each is designed. The buckets being both filled with water from the spring, which affords a fall of ten feet, the larger bucket A, being heavier when full, though the lighter empty, descends the ten feet from C to D, and weighs up the lesser bucket, from E to F, perhaps 30 feet, where touching a trigger it discharges its water into a cistern W, whence it is conveyed for service by the pipe T; at the same time, the water by the like means is discharged (and runs away) from the larger bucket, which then being lighter is drawn up by the smaller (but at that time becomes the heavier) bucket, in order to be filled again at the spring. This work is continued day and night, without any other force, and has not been out of order since it was set up in 1725. The buckets are guided by two iron rods on each side, which run in grooves of the buckets, and the whole motion is kept steady by a jack fly L, which is turned by a spiral wheel at one end of the great axis M; and the other part of the regulator, being a quadrant with a moveable weight at I, is by a proper number of teeth on a communicating wheel suffered to go only in a fourth of a circle, from G to K, and serves as a balance, while the chains of the buckets are winding off and on the wheels.

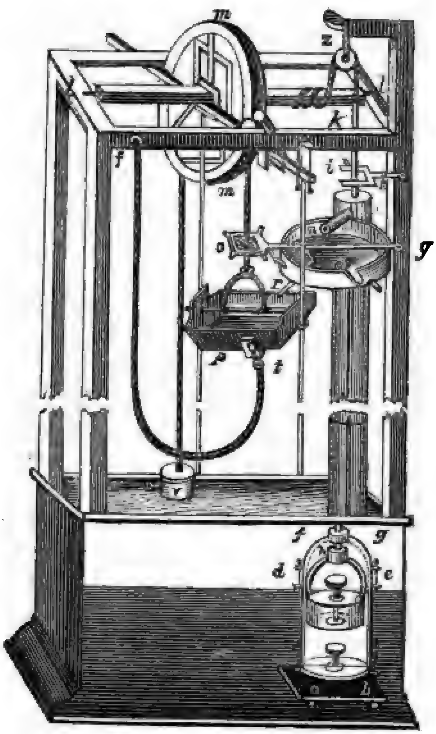
This engine carries up one bucket containing 5 gallons of water in 5 minutes, but then there is a waste of water ten gallons, which are the contents of the larger bucket; but Dr. Desaguliers observes, that it is not the hundredth part of what is spent by a water wheel to raise an equal quantity of water to the same height. The desirable improvement of this engine is to prevent the great waste of water,—and we are informed that can be effected in some degree by Thomas Yeoman, of Northampton.

But the reason of exhibiting this engine, together with that of the German engine (Fig. 1) is from a suggestion, that a round weight might by some means be made to run in and out of a scale or bucket, and so raise up water with very little

(*Fig.* 2, *pl.* 16.)



(*Fig.* 1, *pl.* 18.)



or no waste. We promise, as an encouragement to the attempt, five pounds for the person who first compleats such a work, or produces a model for the like effect.

This, it is apprehended, will be much easier performed than the great operations mentioned by Col. Kranach. However, that person who can come at such a secret will not want five pounds, or a hundred times larger.*

III.—In the Gentleman's Magazine is described a "Self-moving Machine."

A full account of the same machine, with an engraving, as here given, will be found in "Le Journal des Sçavans, 1678 [re-printed Paris, 1724], 4to, page 79, entitled "Le mouvement perpétuel purement artificiel inventé et executé par le P. STANISLAS SOLSKI, Jesuite Poonois." The Magazine article proceeds:—

DESCRIPTION.—Fig. 1, a self-moving machine, invented by a Polish Jesuit. It consists of a pump, whose body *a b f g* is a palm and two fingers' breadth in diameter, and four palms in height; the head *d e f g* is a palm in height; the cylinder *a b d e* of the body of the pump is two palms and a half in height, of which the piston *c c* fills up one palm; the other palm and a half must hold at least five cans of water, each containing three quarts.

The wooden pipe from *f g* to the horizontal pipe *n n* is about thirty-two palms in vertical height.

The author observes that if the diameter of the mouth of the pipe *h n* be equal to that of the cavity of the pump, and the diameter of the iron rod *k k* be of such size as that the pipe *f g n* shall contain only seventeen cans of water, the machine will be the easier work'd, as the water being forced thro' a passage less strait meets with less resistance.

The diameter of the hole *f g* must be equal to half the diameter *d e* of the body of the pump, whence it will be four times straiter than the body of the pump, because circles are to one another as the squares of their diameters.

The machine works in the following manner:—The piston

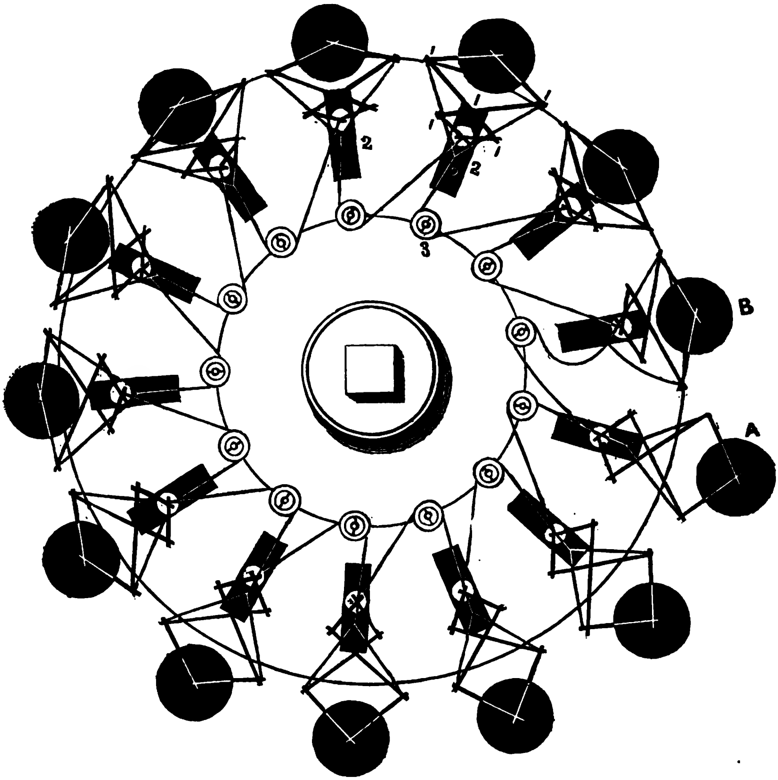
* Vol. 17, 1747, p. 459.

c c being at the bottom of the pump, the suckers, both of the pump and of the piston, shut by their own weight, whence by the descent of the bucket *p*, the wheel *m m*, six feet in diameter, is turned, by which means the chain *k z*, by passing round the axis *l l* of the wheel, raises the iron rod *k h*, and the piston *c c*, at which instant the sucker of the pump opens, and gives passage to the water, which is forced into the body of the pump by the weight of the external air. The counterpoise *v* descends, and so turns the wheel *m m*, round which goes the cord *m m o*, which, descending on the other side, raises the bucket.

In proportion as the counterpoise *v* descends, and the bucket *p* is raised, the axis of the great wheel is freed from the twistings of the cord, and so the piston by its own weight, and that of the iron rod, falls down to the bottom of the body of the pump, and by that means the sucker of the pump shuts, and the five cans of water mount up thro' the piston by its sucker, which opens above. The same operation is readily performed again, in order to carry that water into the pipe *f g n n i*, whence it is discharged thro' the horizontal pipe *n n* into the basin, which holds at least thirty-two pounds of water. This water falls into the bucket *p*, thro' the pipe *q r*, whose clap opens, being raised by two cross sticks, which are fastened to the cord, and lift up the bar *o y*.

The bucket *p* contains four cans and a half of water; it is two palms in length, ten at the opening, and six inches in depth, where the two long faces uniting form an angle of 120 degrees: being thus filled, it descends apace, and the bar *n o* being depressed, the clap falls and closes the pipe *q r*, and as it descends 30 feet, and as the great wheel is 10 feet in diameter, it makes an entire revolution, and thus the axis *l l* twisting up the chain *k z*, the rod *k b* raises anew the piston *c*, and carries again at least four cans and a half of water into the basin *n q*, thro' the horizontal pipe *n n*.

The bucket, when descended almost to the surface of the water of the well, is raised again by the cord *s t*, which is too short to reach the water, and being for the present discharged of its weight, the piston descends to the bottom of the body of the pump, by its own weight and that of the rod *h k*, and the cross sticks *o* of the cord of the bucket coming under the bar *o y*, raises it together with the clap, that the water of the basin *n q* may fall again, thro' the pipe



1
1
1
1
1
1
2
2
3
B
A

q r, into the bucket *p*, causing it to descend anew, and so maintain a perpetual motion.

There are several other small pieces in this machine, the use of which is easily comprehended.*

IV.—A new plain draught of a Self-moving Wheel, tho' not perpetual; with a description of its parts, and manner of operating; submitted to the inspection and amusement of the curious.

Directions to make a Self moving Wheel.

Let there be a well-turned board, of at least two feet diameter.

At Fig. 1, six pins for the chequers to turn upon.

At Fig. 2, let in brass grooves into the board for the receiving of rollers, which must be fastened to the bottom points of the small chequers.

At Fig. 3, place pullies.

At the points of the small chequers fasten chains that pass round the pullies, and are made fast to both points of the next large chequer; the chains must be all of an equal length.

Make very substantial brass chequers, with good joints to play free without wriggling, and of as large a size as the circumference of the wheel will admit, and fix weights at the points of the said chequers.

Remarks upon the manner of Operating.

Observe, that one pound, placed at the zenith of the larg chequer, is correctly equal to two pounds placed at the nadir of the small chequer; and that this power (if occasion be) may easily be either increased or diminished at pleasure, by only fastening the chains farther off or nigher to the weights: therefore, it is self-evident that the weights above the horizon cannot want full power for the drawing in of all the weights below it; more especially those particular weights that arrive gradually to the mounting side of the wheel, as is shewn hereafter. And this is done by reason of the chains being all in a diagonal position, therefore the weights below the

* Vol. 21, 1751, p. 391.

horizon cannot be otherwise drawn in by such slant lines, than into a gradual, regular, elliptical form, as they appear in the plate. But to prevent the said weights from being either too much or too little drawn in, this diagonal position of the chains may, by means of the pullies, be made to slant more or less, so as to answer to the right elliptical form of drawing in the weights as shall be requisite; and thus, by this elliptical form of the weights, the power of gravity must needs give the wheel some considerable share of movement, so as to cause the weight B, &c., to descend below the horizon, where they will run out to the same length, as you see the weight A does, to the very great and constant supply of power to the descending side of the wheel.

As to the mounting side of the wheel, by the manner of chaining the chequers to each other, they become partly as it were all of one piece, so that the weights above the horizon can no way press down their chequers, without communicating their drawing-in power to, and being always felt, in a certain measure, by every weight of the wheel, in the elliptical manner above mentioned, with respect to the diagonal position of the chains. Moreover, whatever number of weights shall descend below the horizon on the one hand, the like number of weights must ascend above it on the other, where they, in conjunction, will press down their chequers with ample force, for the gradual drawing-in of those extended weights which are their next followers, reducing them into the same less extended form as they themselves were in just before they were carried above the horizon. After the same gradual manner, by the power of the weights above, will all the extended weights be thus gradually reduced, drawn in, and carried round, when, at the same time, the elliptical form of the wheel, by the constant supply of weights running out at the descending side, will at all times be kept up, like as at the first setting off of the wheel, for the continuance of the movement.

By all which it appears that there are two different and distinct acting powers in this wheel, both which, by the freeness of the joints and other parts, in a workman-like manner, cannot but act with that puissance as to leave no room to reflect upon friction in any respect whatever.

Therefore, if, upon due inspection, no objection shall appear against either of the said powers, is not here a discovery of a

new power in a short, easy, obvious manner, capable of any improvement in proportion to the size of the wheel, so as to be applicable to ten thousand different uses, both great and small?

Suppose we compare this wheel with the Marquis of Worcester's great wheel (see vol. 18,* pp. 9, 61, 107), some time since shewn in the Tower of London, there will appear the following most material differences:—His wheel was contrived with loose, running weights, forty in number, of fifty pounds each; which, at the nadir, bore the same distance from the centre as the weights at the descending side, upon which account, no such contrivance can possibly ever answer the design to keep moving, as is easily demonstrable; whereas, in this wheel, the weights at the nadir will at all times be considerably nigher the center than the weights of the descending side, the consequence of which wants no explaining. And should one of these wheels be made up for any large use, and, by mistakes in the workman, it be so made as not to answer fully to the purpose, as mentioned above, still the same would be of exceeding great service by being applied to co-operate with the powers of a fire engine, for the raising of double the quantity of water they now raise, which is the same thing as the saving of half the quantity of coals that are now consumed.†

*** As a considerable wager is depending whether a model, upon these principles, can be made to operate, any artist, who imagines that he can make such a one, at a moderate price, may send his terms in writing to E. Cave, at St. John's Gate.

The Self-moving Wheel shewn to be defective by a Mechanical Demonstration.

MR. URBAN,— * * * What I have here sent you is an attempt to prove that the wheel with weights, described in your last magazine, tho' put in motion by the hand, will not continue and preserve that motion any better than a common plain wheel would. * * * *

In the following demonstration, I suppose, and take for

* Where a copy is given of the Marquis's Century of Inventions, with original remarks on each.

† Vol. 21, 1751, p. 448.

granted, that Mr. A. B., by his self-moving, tho' not perpetual, wheel, as he terms it, means such a wheel as, by the action of gravity alone, would continue in a regular uniform motion round its axis, till some of the parts of it are decayed or out of order. I suppose, too, since he says nothing to the contrary, the weights are all exactly equal. And I suppose and allow that such weights, fitted to the wheel in the manner he directs, would, by the action of gravity, so form themselves as to be constantly farther distant from the center of motion on the descending side than on the ascending. It must be allowed, too, that any weight so fixed (or, to speak more properly, the center of gravity of it) would, in every entire revolution of the wheel, describe a curve line returning into itself again, and that all the other weights would successively describe the same curve—perhaps not of a regular elliptical form, as Mr. A. B. imagines, but quite irregular in its shape. However this be, it matters not, so long as a line passing perpendicularly thro' the center of motion, and produced both ways till it touches the curve in two points (which points we shall call the zenith and the nadir, and suppose to be marked with the letters Z and N), divides it into two unequal parts, whereof that through which the weights descend is the largest and most distant from the center of motion, as, from what has been already granted, must be the case here.

These things being premised, let us now examine what power gravity will supply any one single weight with, to continue the wheel in motion: let us call this weight W. Now, 'tis plain that W, in its passage from the zenith to the nadir, thro' the greatest and most distant part of the curve, will yet descend perpendicularly, or get nearer to the center of the earth only as much as comes to the length of the line Z N. In its further progress from the nadir to the zenith, from whence it first set out, tho' it be thro' a less and nearer part of the curve, it will, notwithstanding this, ascend perpendicularly, or recede from the earth's center the length of the same line N Z; and, therefore, since the weight W is obliged, in every entire revolution, to ascend perpendicularly thro' as large a space as it descends, it follows that the reaction of gravity upon it, whilst it is in the ascending part of the curve, will be exactly equal to the action of gravity whilst in the contrary part of it; whence 'tis plain that, upon the whole, this particular weight W will not be supply'd, by

gravity, with the least power to continue the wheel in motion, tho', by application of the hand, it was once set agoing. The same will hold true of every other weight fixed to the wheel; and therefore all the weights, be the number what it will, will have no power at all, upon the whole, to continue the wheel in motion; so that (if we abstract from what difference may be caus'd through friction—resistance) this wheel would continue moving no longer than any common plain wheel would that had the same velocity at first given to it by the hand. Q.E.D.

But to make this still plainer, instead of one, let us consider two opposite weights together, and examine wherein the material difference lies between the action of two equal weights so placed in this machine, and of two others fixed to the ends of any common lever, whose center of motion is at some distance from its middle point. Now, with respect to the lever, let the two equal weights fixed to it be called W and X. Let W be that which is farthest from the center of motion, and let the lever be placed in a horizontal situation. The reason why W will in this case preponderate, tho' the weights be equal, is because it can approach the center of the earth faster than it obliges X to recede from it; for W, in passing from its first position to its lowest point—that is, till the lever becomes vertical—will have got nearer to the center of the earth, just as much as comes to its own distance from the center of motion, and X, in the meanwhile, will have ascended thro' a space equal to its distance from the same; but the distance of X from the fulcrum, or center of motion, was, by supposition, less than that of W; and, therefore, since W in this case does in the same time descend further than it obliges X to ascend, it necessarily follows that it can and does descend faster, which is the reason of its preponderating and causing the lever to move.

But the case of two equal and opposite weights that are fixed to Mr. A. B.'s wheel is quite different; for, let the two weights be here, also, called W and X, 'tis plain that in the same time that W moves from Z to N, X must move from N to Z; in which time also X will have ascended just as much as W has descended, or will have receded from the center of the earth just as much as W has approached towards it: the recess of the one and the access of the other being equal to the same line Z N. And therefore, tho' the absolute velocities

of W and X may be, and are, very different (W in this case describing a larger part of the curve, whilst X describes a less), yet will their perpendicular velocities be the same; and, consequently, since the two weights are, by supposition, equal, W will not preponderate or cause X to move. The same may be said of every other pair of weights that are opposite, and therefore all the weights on the descending side will not preponderate or cause the wheel to move. Whence 'tis plain again that Mr. A. B.'s wheel with weights is no better disposed to be put or continue in motion, by the action of gravity upon it, than any common plain wheel is. Q.E.D.

Mr. Urban,—Now I am writing to you upon this subject, I shall beg leave to add a short general demonstration, to shew that it is utterly impossible for any wheel whatsoever, by means of weights affixed, to be so contrived, as, by the action of gravity alone, to be put and continued in motion round its axis, even so much as for one single revolution.

'Tis a well-known truth in mechanicks, that if gravity, acting on any body, can't move the center of gravity of that body, it can't move the body at all. Now, a wheel furnished with weights, in any manner whatsoever, may be considered as one complete body, the center of gravity of which can either be made to move, by the action of gravity upon the body, or it can not. If the line of direction of the center of gravity of this complex body passes directly thro' the center of motion, in this case, the center of gravity, and, consequently, the body itself, will not be moved at all by the action of gravity alone; but if the aforesaid line of direction passes on one side of the center of motion, in this case, as the center of gravity is not immediately sustained, it may therefore descend, and the wheel may move;* but this center of gravity, by the action of gravity on the body, will never be made to perform a whole revolution round the center of motion; it will only vibrate for some time in the

* I say that in this case it *may* descend, but not that it always *will* do so; for tho', in the wheel of the Marquis of Worcester, and of Mr. A. B., the line of direction of the center of gravity of the whole machine passes on one side of the center of motion, and at a considerable distance from it, yet in such machines, tho' turned by the hand, the center of gravity will not move at all, but is as much fixed as if it coincided with the center of motion.

manner of a pendulum, which vibrating motion, by unavoidable friction and resistance, will be soon destroyed, and the body, with its center of gravity, remain at rest without having performed so much as one single entire revolution. Q.E.D.

If the publishing of what has been here said gives such satisfaction to the publick as may prevent any future attempts of this kind, which have hitherto always proved fruitless, and frequently very expensive, and which, I am thoroughly persuaded, can never be successful, my end is answered; but if not, I shall at least have the satisfaction myself to think that it can do no harm in the world, which is more than can be truly said of many things that have lately appeared in print.

Twiford, Nov. 20, 1751. T. P.*

Mr. Urban,—Reading in your last Magazine, p. 501, Mr. T. P.'s attempt to prove the wheel with weights, described in your last October Magazine, p. 449, tho' put in motion by the hand, will not continue moving any longer than a common wheel would; when, at the same time, he allows that weights so fitted to a wheel, in the manner directed, would, by the action of gravity, so form themselves as to be constantly further distant from the center of the wheel on the descending side than on the ascending; he also allowing that weights so ordered would, in every revolution of the wheel, describe a curve line, returning into itself again, and that all the weights of the wheel will describe the same curve, and, by consequence, granting, though he does not mention it, that the weights at the bottom of the wheel, as well as all those at the mounting side, will be always nigher the center than the weights at the descending: these things being supposed must infallibly render the wheel constantly lapsided, which is all that is, or need be, required to continue its motion. Whatever may be in old objections, against old contrivances, is one thing, but to contrive to have the weights at the bottom of the wheel, as well as the weights at the mounting side, to be always nigher the center than the weights of the descending side, I take to be a quite new discovery, and is

* Vol. 21, 1751, p. 501.

more than can be said of any former contrivance whatever; but as to the consequences of this promising contrivance, I cannot see how it can be any further known, without making of the experiment.

I am, &c.,

Queen Street, Westminster. M. B.*

V.—Perpetual Motion proposed to be effected by Magnetism. —Alleged discovery by Hero Hicken, of Friezland.

Mr. Urban,—Ever since I became acquainted with the mechanical powers (which is now near seven years ago), the greatest part of my leisure time has been employed upon inventions for the good of the publick. Each branch of experimental philosophy has in turn engaged my attention; and I might also add, that each has in turn —— but modesty forbids me to proceed. Yet I must tell you, that if the attraction of the loadstone would have supported a weight at the distance of but $\frac{3}{4}$ of an inch (which a printed book affirms for a truth), gravity before this time had been useless in clockwork, and the longitude effectually discovered. I was extremely sorry, as you may very well suppose, that so useful a scheme should miscarry; and so much the more, as I was within less than an inch of it. But disappointments, Mr. Urban, we must expect to meet with, as my attempts upon perpetual motion have often experimentally taught me. For that, you must know, in spite of demonstration, has ever been my favorite pursuit, and many are the projects that I have successively been big with; some lasted a week, some a fortnight, but a month most commonly put an end to them all. But, however, I have at last succeeded. My present scheme had overcome every objection that either my own head, or my neighbour's, could possibly bring against it; and I was drawing out a plan of it to transmit to you, when the following article appeared in the "Gazetteer:"—

"A paragraph from Amsterdam, in the last 'Utrecht Gazette,' says, that at Doornum, in East Friezland, a mechanic, named Hero Hicken, has invented a machine, which, being

* Vol. 21, 1751, p. 610.

once set in motion, keeps going perpetually, till such time as the materials of which it is composed are fallen to decay, or the structure of the machine itself altered."

It is impossible for me to tell you, Mr. Urban, what a terrible damp this threw upon my spirits; in spight of all my philosophy, I was neither able to eat, drink, or sleep, for a considerable time after. For this was not only a full demonstration that my scheme was practicable, but also attended with this melancholy circumstance, that England would lose the honour of it.

As a month has now elapsed since I met with the above account, without any further confirmation of it, my uneasiness is greatly abated, and I now begin to flatter myself, that either M. Hicken's project has failed, or that the whole account is only one of those periodical paragraphs that appear once in about thirty years. But, as my situation does not permit me to make a strict enquiry into the truth of these matters, I freely resign that office to those of your readers who have leisure enough to examine the arcana of newsmongers, or money enough to take a tramp to Doornum.

I am, &c.,

ANDREW DOSWIL.

EXPLANATION OF THE MACHINE.

A B C D represents a frame of brass or wood for the machine E F to run in.

E and F are two brass wheels, similar and equal, fixed upon a moveable axis G.

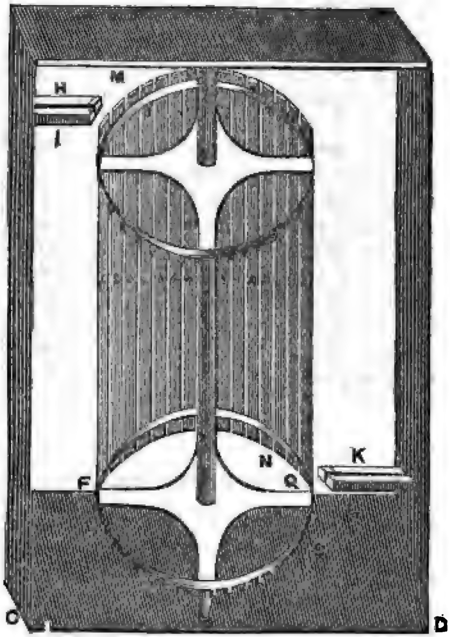
1, 2, 3, &c., are a number of artificial magnets, placed within the teeth of the wheel all round, and as near each other as is possible, provided they do not touch; their north poles at E, and their south poles at F.

H and I are two similar and equal magnets fixed in the brass plate A C, very near each other, but not touching.

K and L two more fixed in the brass plate B D.

Now, as the north pole of one magnet repels the north pole of another magnet, and attracts the south; and inversely the south pole of one magnet repels the south pole of another, and attracts the north; so the south pole, I, attracts all the north ones at E; and the north pole, H, repels all

the north ones at M. In like manner, K attracts at N, and L repels at O, and by this means the whole machine E F moves perpetually round.



N.B.—As the success of the machine depends a good deal on the nearness of the poles, the twentieth part of an inch is the thickness I would recommend for the magnets; the proportion of every other part is as the artist pleases. The magnets are to be put, not flat, but edgeway to the wheel; and to prevent anything affecting their virtue after they are touched, a brass ring to slide over the whole will be most convenient.*

* Vol. 33, 1763, p. 439.

VI.—Under the title of "A new-invented Machine for Raising Water," appears a letter—

To the Society for the Encouragement of Arts, Manufactures, and Commerce, the following proposal is with great deference submitted, by their most obedient humble servant,

RICHARD BLACKWELL.

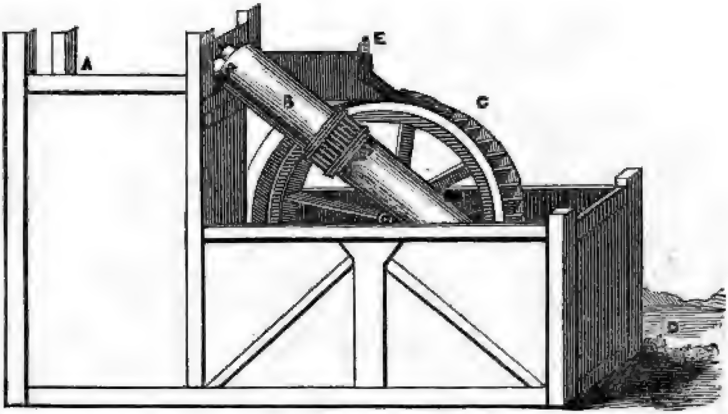
MR. URBAN,—Having read your Magazine for July last, wherein you have obliged the public with a print of that curious engine* for raising water in Kew Gardens, erected by the ingenious Mr. Smeaton, it put me in mind of what I have often thought of—viz., that (upon the principle of Archimedes' water-screw) a machine might be contrived to raise water perpetually, by means of an over-shot wheel applied to the said screw, agreeable to the annexed drawing. On this principle I once undertook to construct a model of such a machine, but other employments not permitting me to finish it, I cannot ascertain the success; yet I conceive the water which may be raised by the revolution of the screw, when applied to the overshot wheel, will be more than sufficient to keep it in constant motion; and the surplus water may be applied to many useful purposes in life.

The great utility of such a machine is very obvious, especially among the seats of our nobility and gentry, many of whom are so unhappily situated that they have no convenience of water but at a continual expense of bringing it from some distant place; whereas, could they raise it to a sufficient height, they might constantly be supplied without any trouble. Add to this the great advantage this machine may yield in pleasure gardens, and the infinite service the reservoir of water would be in cases of fire.

If by experiment it should appear that the water raised by the screw is more than sufficient to supply the over-shot wheel, the whole may be employed to add more power to that wheel, which may then be applied to many useful purposes where mill-work is applicable.

* An Archimedes screw, erected in 1761. When worked by two horses, it supplies the lake and basins in the gardens with upwards of 3,600 hogsheads of water every twelve hours.

The whole is submitted to those gentlemen whose knowledge in hydrostaticks renders them proper judges of such matters.



A, the reservoir.

B, the Archimedean screw, by the revolution of which the reservoir is supplied with water.

C, the over-shot wheel, by the force of which the screw is kept in constant rotation.

D, a small rivulet, or spring, which supplies the well with water.

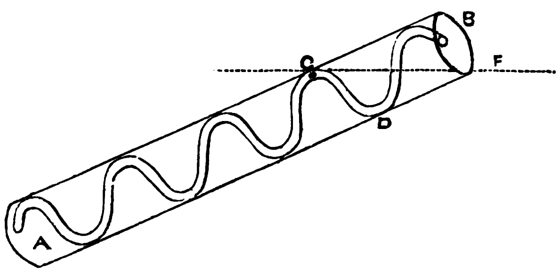
E, the bolt to regulate the flux of the water into the over-shot wheel.*

Mr. Urban,—The ingenious gentleman whose plan of a machine for raising water by a perpetual motion you inserted in your Magazine (see p. 448) was, I am afraid, too sanguine in his hopes of success. Were the slowness of the motion in this machine in proportion to the force with which it is expected to operate thoroughly considered, I imagine no practical trial need be made to convince us of the fallacy of its contrivance. First, then—

The water which is thrown up by the screw can never be able

* Vol. 33, 1763, p. 448.

to turn the wheel, both because of the smallness of its quantity and the slowness of its ascent through the screw, in proportion to its descent down the wheel; for even supposing the screw to turn round twice (which is more than appears from the plan before us) whilst the wheel turns once, yet no more water can be thrown up by each revolution of the screw, than is contained in that part of its uppermost helix, which lies above an horizontal line drawn through the middle of the screw. (See the annexed diagram, A B.) Now, can twice this quantity of water be supposed to turn this wheel round—especially when the stream in which it falls, falls by fits, and is intermitted till the return of the mouth of the upper helix of the screw to the surface of the reservoir? But though we suppose even this to be possible, if the screw were suspended at its center of motion, yet we can scarcely allow it to be so, when the screw is far from being thus suspended, and consequently far from that equilibrium which is alone consistent with an easy and regular motion. That this must be the case in this machine will, I hope, be sufficiently demonstrated from the annexed diagram.



A B represents a screw covered over; C D E one helix or revolution of it; C D the side that is to ascend; E D the descending side; the point D the middle; the horizontal line C F showing how much of the helix is filled with water, viz., of the ascending side, from C, the beginning of the helix, to D, the middle of it; and, on the descending side, from D, the middle, to the point G, where the horizontal line cuts the helix. Now it is evident that this latter part D G is nothing near so large, nor, consequently, so

heavy as the other (ascending) part D C. And thus it must be in all the other revolutions which, as they are either more in number or larger in diameter, so much must the difficulty increase: from whence it appears that the outward stream must be of force sufficient to overcome the difference of weight in the ascending side of the screw, which can scarcely be effected by any contrivance of this sort; for though the water-wheel might be made larger, yet the velocity of the motion which it could communicate to the screw would be inversely diminished.

Most of the arguments I here make use of are to be found in a book of Dr. Wilkins', wherein he also mentions a contrivance to multiply the same stream so as to apply it several times to the same screw;* but even with this addition it is impossible.

I send this letter with no other view than to prevent any persons making an experiment which must be attended with a disappointment so expensive; nor, indeed, could any one speak with another view against an artist who seems so ingenious and so modest. Your Magazine, Mr. Urban, bringing forth to public view these efforts of invention, must be an incentive to enquiries of this nature, which may be of the greatest service to society. I cannot, therefore, better conclude this letter than with the words of the author I above mentioned:—"However, the enquiry after it (the perpetual motion) cannot but deserve our endeavours, as being one of the most noble amongst all these mechanic subtelties. And, as in the fable of him who dug the vineyard for a hidden treasure, though he did not find the money, yet he thereby made the ground more fruitful; so, though we do not attain to the effecting this particular, yet our searching after it may discover so many excellent inventions as shall abundantly recompence the labour of the enquiry."

I am, Sir, &c.,

J. S.†

* See Chapter I.

† Vol. 33, 1763, p. 554.

VII.—Alleged discovery by William Ashman.

Horsley, Gloucestershire, Nov. 12, 1800.

MR. URBAN,—I beg you to announce that Mr. William Ashman, hatter, of this place, has this day been with me and asserted that he has discovered the perpetual motion, *i.e.*, that he has invented, and actually possesses, a self-moving machine, which, when once set going, will continue so till worn out. He also says it is applicable to the greatest objects and most useful purposes. I have thought it my duty to communicate his assertion to Sir Joseph Banks.

T. D. FOSBROOKE.*

VIII.—Perpetual Motion by Galvanic agency.

The perpetual motion, so long sought for in vain, is now sought through the medium of galvanism. A French physician has in his cabinet two galvanic piles, 16 inches high, which alternately attract a pretty heavy beam. The continual oscillation of the beam gives motion to a pendulum, which has never stopped for the last three years. The physician is now endeavouring to give to this movement an isochronism which may render it more useful.†

IX.—An ancient attempt at Perpetual Motion.

MR. URBAN,—In the curious preface of the learned Dr. Dee, prefixed to his Euclid, is the following remarkable passage in the article "Trochilike." If any of your ingenious correspondents can furnish an explanation of so odd a piece of mechanism, it will afford much satisfaction to

A CONSTANT READER.

"By wheels, strange works and incredible are done, as will hereafter appear. A wonderful example of further possibility and present commodity was seen in my time, in a certain instrument, which by the inventor and artificer (before) was sold for twenty talents of gold, and then had (by

* Vol. 70, part 2, 1800, p. 1128.

† The "Abstract of Foreign Occurrences," in the "Gentleman's Magazine," vol. 87, part 2, 1817, p. 170. The same in vol. 88, part 1, p. 63.

misfortune) received some injury and hurt. And one Janellus of Cremona did mend the same, and presented it unto the Emperor Charles the Fift. Hieronymus Cardanus can be my witnesse, that therein was one wheel which moved, and that in such rate, that, in 7000 years, only his own period should be finished. A thing almost incredible: but how farre I keep me within my bounds, very many men (yet alive) can tel."

Quere. Does not the doctor intimate this machine to be very ancient by the mode of fixing the price? Talents have not, I believe, been used in reckoning by any moderns. I desire likewise to be informed whether he refers to the verbal or written testimony of Cardan? If the latter, in what part of his works is an account of the same wonderful automaton to be found?*

X.—Dr. Kenrick and J. D. Muller make application for Patents.

Dr. Kenrick† and Mr. John Dietrick Muller waited on the Attorney-General: the first with reference from the Court of Chancery on a petition for a patent for the exclusive benefit of a discovery of a mechanical principle, of self-motion, for the construction of machines which acquire a constant supply of power from the action of gravity on themselves only; the latter, on a like reference, for the invention of a machine or engine constructed on self-moving principles. The Attorney-General, on hearing the merits, was pleased to make his report in favour of both parties.‡

XI.—A Magnetic Scheme suggested.

Mr. Urban,—How frequently do we find ourselves in the situation of the author in the farce of the "Critic," who having been discovered in a plagiarism, is driven to his shifts

* Vol. 47, 1777, p. 441.

† Probably the invention alluded to, but not described, in his lecture (Chapter III.); and elsewhere called "The Rotator."

‡ The "Historical Chronicle," in the "Gentleman's Magazine," vol. 49, 1779, p. 269.

for an excuse, and at length observes, "that all he has to say about it is, that Shakspeare and he had the same ideas, but that Shakspeare used them first" (or words to that effect). In some such light does a rude idea of mine stand just now. About two years ago, or not quite so long, I mentioned to a philosophical friend, who had frequently turned his attention towards the construction of a machine that would afford the long sought for desideration of perpetual motion, my opinion as to what I conceived must be selected as the first principle of any such action. I considered that whatever the power may be which shall keep up an action of that kind, would be found only in nature; and that, however art may assist towards the attainment of the end, it would, nevertheless, be found to be but secondary. I told him the power which I conceived was the one required; and he (on my writing to ask if he remembered the conversation) replies, that he perfectly recollects it; and that the magnet was that to which I alluded. Now, Mr. Urban, I am very far indeed from wishing to claim anything like discovery; but I can only say, that the gentleman in whose behalf the interest of Parliament is about to be sought, "has had the same idea (so far as the magnet is concerned) with me, but has used it first." Mine being, however, but a theory, as I never have attempted to construct the machine I had in my mind, I should justly merit both scorn and ridicule, could I have for a moment the effrontery of putting my hypothesis in competition with the tried apparatus of the gentleman in question. Nevertheless, I may venture to give them on paper, as they may, perhaps, assist in a small degree towards exciting the attention of more philosophical men than myself. I am well aware of the mechanical difficulties that will present themselves, but still do think they may be overcome. The power of the magnet we know to be both attractive and repellent; and as this power exists independent of human agency, I have always looked upon it as the most likely to supply the wants we are anxious to remove. I therefore suppose that a wheel, simple in its construction and like to a water-wheel, might be made to move on a diamond or agate pivot, having its weather boards (I know not if that be the technical term for the parts which dip into the stream or not) armed with iron; the magnet then to be applied nearly vertical and wheel put in motion, when it appeared to me that the attractive power

acting on the extremities of the wheel, on one side of each of the boards and in an opposite power to the other, would continue to propel the wheel with a rotatory motion: the first impetus of course must be given by hand. Rude and untried as my plan is, I cannot but think it practicable, and trust that you will oblige me by giving it a place in your publication, as through such a channel of scientific information it may, perhaps, assist some to form new ideas, or to induce others to correct the erroneous one (if it be such) of

Yours, &c.,
ALPHABETICUS.*

XII.—Spence's Motion by Magnetism.

John Spence, an ingenious individual, residing at Linlithgow, in Scotland, has applied the magnetic power to the production of a perpetual motion. This person was in early life apprenticed to a shoemaker, but the natural bent of his genius for mechanics overcame every obstacle; he got to be keeper of a steam-engine in a spinning factory at Glasgow, and after two years' study in this school, retired to his native place to pursue the shoemaking for bread; and wheels, levers, &c., for the gratification of his own taste. The perpetual motion was an object worthy of such a devotee, and we find that he has invented a piece of mechanism which is doubly curious, from its own powers, and from the extraordinary difficulties in whose despite it has been accomplished. It is not easy to convey an idea of it without plates. A wooden beam, poised by the centre, has a piece of steel attached to one end of it, which is alternately drawn up by a piece of magnet placed above it, and down by another placed below it: as the end of the beam approaches the magnet, either above or below, the machine interjects a non-conducting substance, which suspends the attraction of the magnet approached, and allows the other to exert its powers. Thus the end of the beam continually ascends and descends betwixt the two magnets, without ever coming into contact with either; the attractive power of each being suspended precisely at the moment of nearest approach. And as the magnetic attraction is a permanently operating power, there appears to be no

* Vol. 88, part 1, 1818, p. 391.

limit to the continuance of the motion, but the endurance of the materials of the machine. The first machine made by Mr. Spence is very rude, and fashioned by his own hands, but he intends applying the principle to the motion of a time-piece. We trust this ingenious man will meet the encouragement he deserves—if not as the reward of his talents and perseverance, at least for the benefit of the community, for it is from such sources that great national improvements are often derived.*

XIII.—A Wheel moved by Magnetic influence.

The piece of mechanism consists of only one small horizontal wheel, not exceeding 3-4ths of an inch in diameter, through the centre of which, on the plane of the wheel, passes a small magnetic bar, projecting about 3·4ths of an inch beyond the circumference of the wheel on the one side, and about 3-8ths of an inch on the other side. These projections are called the north and south poles. The axis of the wheel is of course perpendicular. Its operative power is magnetism; its motion (probably owing to the friction inseparable from the long-continued action of the axis in its sockets) is somewhat irregular; but on the whole it is a curiosity highly deserving attention. Owing to a sudden shock, its motion was stopped entirely the other day, but we have learned that it has been restored. About two years ago it was stopped by some unknown cause, but after a short pause recovered its motion of itself, without any additional impulse, and continued its revolutions without intermission. In a room at Mr. Swan's, in Coppergate, which was excessively warm, and crowded with company, its action ceased altogether, after first becoming irregular and sickly. Query.—Might not this simple fact lead to some important issue on the question of the variation of the compass? This we only know, that the magnetic influence was deadened by excessive heat, and resuscitated by more moderate atmosphere.—*Yorkshire Gazette.*†

* Vol. 88, part 2, 1818, p. 156.

† Vol. 91 (July to December, 1821), part 2, p. 628.

In the "Annual Register," for 1774, is a "Description of the curious Time-piece in Mr. Cox's Museum:"—

Among other great works now introduced at Mr. Cox's Museum is an immense barometer, of so extraordinary a construction that by it the long sought for, and in all likelihood the only perpetual motion that ever will be discovered is obtained. The constant revolution of the wheels moving in vertical, horizontal, and other directions, is not only physically produced, but the indication of time from an union of the philosophic with the mechanic principles is effected. Upon the dial, besides a minute and an hour hand, is another hand dividing the minute into 60 equal parts. These hands are motionless till affixed to the primary motion, so that the motion of the time-piece (as Mr. Cox in his descriptive inventory judiciously expresses it) is originated, continued, and perfected, by the philosophic principle through which it is (solely) actuated.

The encouragement Mr. Cox has, for many years, given to men of genius, and the perseverance with which he has pursued the great line of utility, have not only given birth to productions that have astonished all Europe, as well as the eastern world, but have at last produced the wonderful machine above described. Several of the most eminent philosophers and mathematicians in this kingdom, who have examined it attentively, are of opinion that it will lead to farther improvements both in philosophy and mechanics; and we hear that Mr. Cox intends to devote a part of every week to the gratification of such gentlemen in the scientific world as wish to be acquainted either with the construction or the mode of operation, the principles of action or the masterly execution of so capital a performance. This article is, we are informed, one of the prizes, and the work of many years, during which time numberless ineffectual and expensive trials were made, which perhaps would have damped any ardour but Mr. Cox's, and probably prevented the world from ever being benefited by so valuable a discovery.

"I have seen and examined (says Mr. James Ferguson, in a letter dated Bolt-court, Fleet-street, Jan. 28) the above-described clock, which is kept constantly going, by the rising and falling of the quicksilver in a most extraordinary barometer; and there is no danger of its ever failing to go;

for there is always such a quantity of moving power accumulated as would keep the clock going for a year, even if the barometer should be taken quite away from it. And, indeed, on examining the whole contrivance and construction, I must with truth say that it is the most ingenious piece of mechanism I ever saw in my life."

For a further account of this extraordinary machine, see Mr. Cox's descriptive inventory of his museum.*

Alleged discovery in France, by M. Dodemant:—

A machine, capable of being set in motion, and producing a powerful effect, without either the intervention of any combustible, the action of any current of water or of air, or the exertion of animal strength, but possessing within itself the inexhaustible principle of motion, would doubtless prove of great utility to mankind. Such is that of which M. Dodemant, professor of mathematics at Lyons, announces himself the inventor. At his request, the prefect has directed two persons—M. Carron, chief engineer of the department, and M. Moller, professor of natural philosophy—to examine this machine.†

The following, referring to Geiser's imposition and Zamboni's Column, is extracted from an article headed "The most important inventions and discoveries of our times," which in a note we are informed is "from the German of M. Poppe, of Tubingen:"—

Many able mechanicians have been endeavouring to discover a *perpetuum mobile;* but many, who thought themselves on the point of succeeding, found their hopes deceived, and the phantom they had pursued eluded their grasp. The clock of M. Geiser, an admirable piece of mechanism, seemed to have solved this great problem in an ingenious and simple manner; but it deceived only for a time, not only the author of this essay, but many of the most excellent mathematicians; for in this clock springs were concealed in the most artful manner, which were wound up at certain times, to aid the apparent power, which was not able alone to keep the machine in

* The Annual Register, vol. 17, 1774, p. 248.

† The Monthly Magazine, vol. 22, part 2, 1806, p. 67.

motion. Above a year ago, the author of this article discovered this trick, with several other lovers of the arts, who had joined with him to examine the machine; and he soon after made his discovery public.

The column of Zamboni, and the clock connected with it, by that artist, at Verona, which have now gone, without interruption, for above four years, as well as that of Ramis, at Munich (called the electric pendulum clock), are therefore, perhaps, the best *perpetuum mobile* that we yet have. By this name we of course understand a machine which is able constantly to renew the cause of its motion by its own mechanism, and whose moving principle preserves its action without interruption, and without any new impulse, till it is stopped either by the wear of the machine or by violence. The invention of a machine possessed of this property is indeed very difficult, but not impossible, as Kastner Langsdorff and other mathematicians have demonstrated.*

An imposition exposed in a letter from Mr. Thomas Gill, Chairman of the Committee of Mechanics in the Society for the Encouragement of Arts, &c. &c., of London, to Prof. Thomson, on a pretended Patent Self-moving Engine:—

No. 125, Strand, London, Oct. 4, 1820.

SIR,—My attention has lately been directed to a gross imposition upon the public in a pretended self-moving engine, which is now exhibiting in this metropolis, and which I think it highly proper to expose, and thereby, as far as lies in my power, prevent the delusion from being continued.

It is announced in the following handbill:—

"The newly-discovered patent self-existing engine for propelling ships at sea, carriages on the road, and all kinds of machinery, without the aid of horse, steam, water, or other power now in use. To be seen at work every day, Sundays excepted, from ten in the morning till six at night, at 32, Burlington Arcade, Piccadilly. Admittance, Two Shillings.

"N.B.—Gentlemen intending to have their machinery driven by the above power are desired to apply as above. If by letter, post-paid.

* The New Monthly Magazine, vol. 12, part 2 (July to December, 1819), p. 162.

I found the machine to consist of a light brass wheel, about two feet in diameter, turning upon an horizontal axis, which is supported at each end in square blocks upon the tops of two brass columns, which are affixed to a mahogany table mounted upon a thick pillar of the same wood, with feet and rolling castors, so that it may be moved about, and thereby show that it has no communication through the floor of the room it is exhibited in. The thickness of the table is about an inch and a half, and the pillar is about 6 inches in diameter. Around the periphery of the wheel are fixed at equal distances, by screws, a number of small cylindrical rods or bars of metal, which are placed parallel to the axis of the wheel; and at one end of the frame surrounding the wheel (and which frame is besides supported on two other brass columns) is a brass pillar, which has an arm or bracket, on which is fixed, near the periphery of the wheel, a ball, which the inventor pretends is formed of a new combination of metals, the composition of which, he says, possesses a new species of attraction, which is not magnetism, for the metal bars on the periphery of the wheel so as to draw each of them in succession continually towards it; but as this attraction takes place equally above and below the ball, he says that he cuts it off below by means of a plate of a different composition of metals, which is placed beneath the ball, and thus he pretends that the wheel is continually turned round by this new attempt at reviving the long since exploded doctrine of attraction and repulsion, and with considerable force, and says that he has in the country a machine of two horses' power. On being asked if he had any pieces of the compound metals with him besides those on the machine, he said he had not, and would not suffer any person to possess them, lest they should take them to pieces, and thereby discover their composition. On being questioned as to his patent, he said that in fact he had none, having merely entered a *caveat* to prevent any persons from taking out a patent for a similar machine without his being informed thereof. So much, then, for his pretended patent; and I verily believe that his new-invented power rests on no better a foundation, and that, in fact, his wheel is turned by spring mounted on a barrel, as usual in spring clocks and other pieces of mechanism, and which is concealed either in the substance of the table itself or in the thic

pillar which supports it, the barrel having a ring of teeth around it, working in a pinion affixed upon the lower end of an upright axis concealed in one of the brass columns that support the horizontal axis of the wheel, and having at its upper end another pinion which works into a small toothed contrate wheel fixed on the end of the horizontal axis, but also concealed in the brass block on the top of the column, and in another pillar which is screwed upon the top of the block, and is quite large enough to contain it, and thus gives motion to the wheel; and, indeed, the artifice is but very clumsily concealed. I should have added that the brass pillar last mentioned supports an upright axis having a pinion at its lower end, which is driven by a contrate wheel on the horizontal axis of the wheel, and which upright axis has at the top of it a fly with wings to regulate the motion of the machine, as in other spring movements.

This barefaced imposition reminds me of another which was practised upon the public several years since, and was detected, and very properly exposed, by my friend Mr. J. T. Hawkins, which put an end to the trick: this consisted of what was said to be a self-moving pendulum, and beneath the bottle of it a ball was placed, out of which, as the exhibitor pretended, an elastic fluid was continually proceeding, which gave an impulse to the ball as it passed over it. Mr. Hawkins, however, found that the impulse was, in fact, given to the pendulum at its upper end; and that the axis on which it hung communicated with another pendulum which was kept in motion by a weight or other maintaining power; for in like manner the real cause of the wheel's motion in this new imposition is concealed, and the attention of the spectator is directed to another pretended first mover, and which is besides attended with the additional advantage of affording him matter for wonder, which constitutes the chief pleasure of the multitude, and contributes greatly to the profit of the exhibition.

I am, Sir, your most obedient servant,

THOMAS GILL.*

* Annals of Philosophy. By Thomas Thomson, M.D. 8vo. Vol. 16, 1820, p. 373.

Mr. G., Editor of the Technical Repository, referred to in Chapter VIII. of the present work.

In the notice given of "Lectures delivered in the Theatre of the Royal Institution," the following occurs, in mentioning "Dr. Young's Lectures on Mechanics:"—

The doctrines of rotatory power and preponderance were considered after those of equilibrium; the apparatus intended for illustrating the effects of rotatory power was not completed; but an experiment was made, in a subsequent lecture, in confirmation of the propositions respecting the most advantageous disposition of power in machines. Six equal weights were attached to as many threads, and each pair of threads was passed in opposite directions round the different portions of three pullies. The first pulley was so formed that its larger portion was to its smaller as 3 to 2; the second was in the ratio of 5 to 2, and the third as 4 to 1; and the three weights, of which the threads were coiled round the smaller part of each pulley, being suffered to rise at the same instant, the middle weight rose evidently much faster than either of the others. Dr. Young, however, remarked that the greatest velocity would not in all cases be practically desirable, on account of the injury that the machinery would sustain from the shock in stopping it. A model of a wheel with moveable weights, for producing perpetual motion, was employed for showing the fallacy of all projects of this kind, and it was observed that a general demonstration of its insufficiency might be deduced from the properties of the centre of gravity.*

In "Œuvres Philosophiques" of M. 's Gravesande, we find his letter to Sir Isaac Newton, already given (Chapter II.), and the following—

Remarks touching Perpetual Motion.

About eight months ago, by order of His Serene Highness the Landgrave of Hesse, I was called upon to examine the effects of a machine at Cassel, which the inventor (Orffyreus) professed to be a perpetual motion. He carefully hid its interior, requiring a certain sum when the

* Journals of the Royal Institution of Great Britain, vol. 1, 8vo., 1802, p. 105.

machine should have been first fully examined and recognised by mathematicians to be, what in mechanics is called a perpetual motion. I was so forcibly struck by what I saw and what I heard of it, as to be unable to call it in question. I was obliged to look on the machine as one of the most beautiful inventions in mechanics that I had ever known, and had only to consider the truth of the effects before me. I wrote to Mr. Newton all I had observed about it, which having been printed, fault has been found with what I advance, saying :—"that I do not believe perpetual motion to be a contradiction;"—"that the demonstrations given on its impossibility do not appear to me as applicable to all machines;"—and, lastly, "that I find it probable that the machine at Cassel may be a perpetual motion." All the difficulty turns on the first of these remarks; if that were proved, the remaining ones would not embarrass me much; and has, no doubt, been found too bold to venture on without proof. In this I quite agree, and I should not have committed the fault had my letter been written for the public. I was so little inclined to advance a proposition without proof, that I have never yet declared what I thought on perpetual motion, foreseeing the judgment that all mathematicians must pass on any one who should turn aside from the generally received opinions. What I considered I owed to truth, after having seen the machine at Cassel, induced me to give Mr. Newton my opinion on it, and at the same time to say what I thought of the proofs of the impossibility of perpetual motion. I must now justify myself before the public.

We must, however, first establish the state of the question. As no foreign agent must be employed, it will be seen that a clock, in whatever way wound up, would not be perpetual motion. It may be what mathematicians have taught under the term of collision, on the power of which they are divided in opinion. All agree that the force of collision is proportionate to the mass. We must admit the possibility of perpetual motion in all machines which would have the principle of their movement in the collision of bodies. The impossibility of perpetual motion has not been shown in all possible cases, affected by collision. And the laws of nature are not yet well enough known to allow our drawing a conclusion that perpetual motion is contrary to these laws.

As it is possible for a body to rise quicker than it descends, on this I found my proof of the possibility of perpetual motion.

Conceive a body falling from one foot high, losing all its movement by the shock; suppose it to fall four times similarly, it would have fallen from the height of four feet, and the four shocks would be equal to the force that the gravity communicated to the body during the four moments of its fall. But it is known that the body could mount in two of these moments to the height of four feet; consequently, the force of two of these four shocks suffices to make it rise, and the two other shocks may be employed to move a machine: so the movement would be continued perpetually by the falls reiterated of the same body, which at each revolution would gain the force of two shocks. The gain of the force would be greater at each revolution, if the number of shocks were increased in the descent. Thus, there is in nature an augmentation of strength, which is sufficient to support the opinion that perpetual motion is not a contradiction—nay, that it is even possible.

This possibility will appear still clearer, if attention is paid to the property of springs, that they rebound with the same force that bound them. This matter was disputed between MM. Leibnitz and Papin, in the "Actes de Leipsic," respecting whether the force of a body was proportionate to its speed; if admitted, Leibnitz considered perpetual motion would be the consequence; Papin admitted the validity of the consequence, but doubted the proposition.

The only means of replying to the arguments brought forward on the possibility of perpetual motion, is to deny with M. Leibnitz the principle on which they are founded.

I should not be able to persuade myself that it is a contradiction to construct a machine which would have in itself the principle of the augmentation of power, in consequence of the laws of nature. These laws are so little known to us, and there is little appearance that they will ever be discovered sufficiently for us to arrive at such a conclusion. To me it seems, that these laws, on the contrary, ought to make us look upon such a machine as very possible, although it may never be accomplished by human art.

The question of the possibility or impossibility of perpetual motion, then, seems to me of little consequence; but it is

desirable that the strong persuasion that mathematicians have regarding its impossibility should not prevent their paying serious attention to such a machine as the astonishing wheel of Cassel; a wheel having the principle of movement internal, and which is moved by the slightest effort, turning either way without any necessity to reverse the moving power; lastly, after making some millions of surprisingly rapid turns, continues its motion until stopped by a strong effort of the arm. It appears to me that such a machine merits some praise, even should it not satisfy all its inventor's representations. If it is perpetual motion, he deserves the recompense he asks; and if not, the public may here discover a beautiful invention.*

[For full details, see Appendix F.]

The resolution of the Royal Academy of Sciences in Paris not to entertain communications relating to Perpetual Motion, was passed in 1775. They say:—

This year the Academy has passed the resolution not to examine any solution of problems on the following subjects:—

The duplication of the cube, the trisection of the angle, the quadrature of the circle, or any machine announced as showing perpetual motion.

We believe ourselves bound to account for the motives which have led to this determination.

* * * * *

The construction of a perpetual motion is absolutely impossible. If even friction and resistance from the middle did not eventually destroy the effect of the first motive power, that power cannot produce an effect equal to its cause; if, then, it is desired that the effect of a complete power should act continually, the effect must be infinitely small in a given time. If the friction and resistance be subtracted, the first motion given to a body will always continue; but it will not act in regard to other bodies, and the only perpetual motion possible in this hypothesis

* Œuvres Philosophiques et Mathematiques de Mr. G. J. 's Gravesande. Amsterdam, 1774. 2 vols., 4to. (Vol. 1, p. 305.)

(which could not exist in nature) would be absolutely useless in carrying out the object proposed by the constructors of these perpetual motion machines. The drawback to these researches is their being exceedingly expensive, and has ruined more than one family; often mechanics, who could have rendered great services to the public, have wasted their means, time, and genius.

Such are the principal motives that have dictated the determination of the Academy. In stating that they will not occupy themselves any longer with these subjects, they only declare their opinion of the complete uselessness of the labour of those who so occupy themselves. It has often been said, that in seeking to solve chimerical problems, many useful truths have been found; an opinion which originated in a time when the proper method of discovering the truth was unknown, which in the present day is well known. It is more than probable that the right manner of discovering these truths is to search for them. But the quadrature of the circle is the only rejected problem of the Academy which could give rise to any useful research; and, if a geometrician should find it out, the determination of the Academy would only enhance his merit, as it would show the opinion that geometricians have of the difficulty, not to say insolubility, of the problem.*

* Histoire de l'Académie Royale des Sciences, 1775. Paris, 1778. 4to. Pp. 61-66.

CHAPTER VII.

DEFINITIONS AND DESCRIPTIONS OF PERPETUAL MOTION, FROM ENCYCLOPÆDIAS AND DICTIONARIES.

GREAT similarity in style and matter will be observed in each of these articles, and the paucity of information they generally afford is evidence how little has hitherto been known respecting what had been done and written on the subject. All speak in the most vague and general terms of the amount of attention devoted to its pursuit,—all claim to demonstrate its impossibility, either on the authority of M. de la Hire, or on one or two examples. Well has M. 's Gravesande observed on the insufficiency of arguments against the possibility of a perpetual motion to meet all known, much less all possible, cases. A false argument, or a weak one, is worse than useless, for the opinionated are only thereby confirmed in erroneous theories.

1.—In the edition of Rees' Cyclopædia for 1819, we read:—

Perpetual Motion, in mechanics, a motion which is supplied and renewed from itself without any external cause; or it is an uninterrupted communication of the same degree of motion from one part of matter to another, in a circle or other curve returning into itself, so that the same momentum still returns undiminished upon the first mover.

This celebrated problem of a perpetual motion consists in the inventing of a machine which has the principle of its motion within itself. M. de la Hire has demonstrated the impossibility of any such machine, and finds that it amounts to this, viz., to find a body which is both heavier and lighter at the same time; or to find a body which is heavier than itself.

To find a perpetual motion, or to construct an engine, &c., which shall have such a motion, is a famous problem that has

employed the mathematicians of two thousand years; though none, perhaps, have prosecuted it with attention and earnestness equal to those of the present age.

Infinite are the schemes, designs, plans, engines, wheels, &c., to which this longed-for perpetual motion has given birth: it were as endless as impertinent to give a detail of them all.

In effect, there seems but little in nature to countenance all this assiduity and expectation: among all the laws of matter and motion, we know of none yet which seems to furnish any principle or foundation for such an effect.

Action and re-action are allowed to be ever equal, and a body which gives any quantity of motion to another always loses just so much of its own; but, under the present state of things, the resistance of the air, the friction of the parts of machines, &c., do necessarily retard every motion.

To keep the motion constant, therefore, either:

First, there must be a supply from some foreign cause, which in a perpetual motion is excluded;

Or, secondly, all resistance from the friction of the parts of matter must be removed, which necessarily implies a change in the nature of things.*

For, by the second law of nature, the changes made in the motions of bodies are always proportional to the impressed moving force, and are produced in the same direction with it; no motion, then, can be communicated to any engine, greater than that of the first force impressed.

But, on our earth, all motion is performed in a resisting medium, and must, therefore, of necessity be retarded; consequently, a considerable quantity of its motion will be spent on the medium.

Nor is there any engine or machine in which all friction can be avoided; there being in nature no such thing as exact smoothness or perfect congruity,—the manner of the cohesion of the parts of bodies, the small proportion the solid matter bears to the vacuities between them, and the nature of those constituent particles, not admitting it. This friction, therefore, will also in time sensibly diminish the impressed or communicated force; so that a perpetual motion

* So far, this is a mere repetition from Diderot and D'Alembert's French Encyclopædia, 1765, folio.

can never follow, unless the communicated force be so much greater than the generating force as to recompense the diminution made therein by all these causes: but *nil dat quod non habet;* and the generating force cannot communicate a greater degree of motion than it hath itself.

Or, thirdly and lastly, there must be some method of gaining a force equivalent to what is lost, by the artful disposition and combination of mechanic powers; to which last point, then, all endeavours are to be directed: but how, or by what means, such force should be gained, is still a mystery.

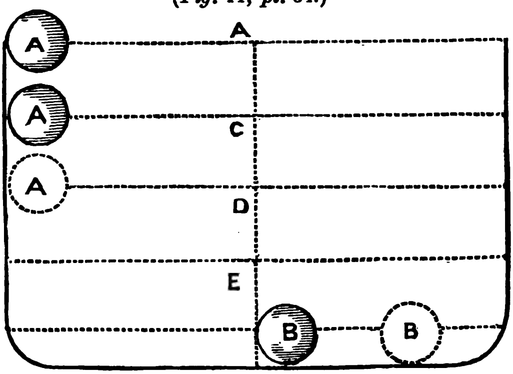
The multiplication of powers or forces, it is certain, avails nought; for what is gained in power is still lost in time, so that the quantity of motion still remains the same. This is an inviolable law of nature, by which nothing is left to art, but the choice of the several combinations that may produce the same effect.

Although it is allowed that, by the resolutions of force, there is a gain or increase of the absolute quantity of force, as the two forces in the sides of the parallelogram taken together exceed the force in the diagonal which is resolved into them, yet you cannot proceed resolving motion *in infinitum* by any machine whatsoever; but those you have resolved must be again compounded, in order to make a continual movement, and the gain obtained by the resolution will be lost again by the composition. In like manner, if you suppose two bodies to be perfectly elastic, and that the lesser body strikes the other at rest, there will be an increase of the absolute quantity of force, because the striking body will be reflected; but if you suppose them both to turn round any centre, after the stroke, so as to meet again, this increase of force will be lost, and their motion will be reduced to its first quantity. Such a gain, therefore, of force, as must be afterwards lost in the actions of the bodies, can never produce a perpetual movement. There are various ways, besides these, by which absolute force may be gained; but since there is always an equal gain in opposite directions, and no increase obtained in the same direction, in the circle of actions necessary to make a perpetual movement this gain must be presently lost, and not serve for the necessary expense of force employed in overcoming friction and the resistance of the medium. We may observe, therefore, that, though it could be shewn that in an infinite number of bodies, or in an

infinite machine, there could be a gain of force for ever, and a motion continued to infinity, it does not follow that a perpetual movement can be made. That which was proposed by M. Leibnitz, in August, 1690, in the "Leipsic Acts," as a consequence of the common estimation of the forces of bodies in motion, is of this kind, and, for this and other reasons, ought to be rejected.

The possibility of a perpetual motion has been urged from the following specious argument:—Let the height A B be

(*Fig.* 11, *pl.* 34.)



divided into four equal parts, A C, C D, D E, E B. Suppose the body A to acquire, by the descent A C, a velocity as 1, and this motion, by any contrivance, to be transmitted to an equal body B; then let the body A, by an equal descent C D, acquire another degree of motion as 1, to be transmitted likewise to the same body B, which in this manner is supposed to acquire a motion as 2, that is sufficient to carry it upwards from B to A; and because there yet remain the motions which A acquires by the descents D E and E B, that may be sufficient to keep an engine in motion, while B and A ascend and descend by turns, it is hence concluded that a sufficient gain of force may be obtained in this manner, so as to produce a perpetual movement. But it should be considered that two equal successive impulses, acting upon the same body, will not produce a motion in it double of that which would be generated by the first impulse; because the

second impulse has necessarily a less effect upon the body which is already in motion than the first impulse which acted upon it while at rest. In like manner, if there is a third and fourth impulse, the third will have less effect than the second, and the fourth less than the third. Hence it appears that a motion as 2, in the preceding case, cannot be produced in B by the two successive impulses transmitted from A, each of which is as 1.—Maclaurin's View, &c., book ii., c. 3. (See Orffyreus's Wheel.) *

In the same Cyclopædia appears the following account of Orffyreus's celebrated Wheel:—

Orffyreus's Wheel, in mechanics, is a machine so called from its inventor, which he imagined to be a perpetual motion. This machine, according to the account given of it by M. 's Gravesande, in his "Œuvres Philosophiques," published by Allamand, Amst., 1774, consisted of a large circular wheel, or rather drum, twelve feet in diameter and fourteen inches in depth, and very light, as it was formed of an assemblage of deals, the intervals between which were covered with waxed cloth, in order to conceal the interior parts of it. The two extremities of an iron axis, on which it turned, rested on two supports. On giving the wheel a slight impulse in either direction, its motion was gradually accelerated; so that after two or three revolutions it acquired so great a velocity as to make twenty-five or twenty-six turns in a minute. This rapid motion it actually preserved during the space of two months, in the chamber of the Landgrave of Hesse, the door of which was kept locked, and sealed with the Landgrave's own seal. At the end of that time it was stopped, to prevent the wear of the materials. The professor, who had been an eye-witness to these circumstances, examined all the external parts of it, and was convinced that there could not be any communication between it and any neighbouring room. Orffyreus, however, was so incensed, that he broke the machine in pieces, and wrote on the wall, that it was the impertinent curiosity of Professor 's Gravesande which made him take this step. The Prince

* The Cyclopædia; or, Universal Dictionary of Arts, Sciences, and Literature. By Abraham Rees, D.D., F.R.S., &c. Vol. 25. 1819.

The first part of this article has incorporated in it that on "Motion, Perpetual," in Hutton's Math. Dict., 4to., 1795.

of Hesse, who had seen the interior parts of this wheel, being asked by 's Gravesande, whether, after it had been in motion some time, there had been any change observable in it, or whether it contained any pieces that indicated fraud or deception, answered both questions in the negative, and declared that the machine was of a very simple construction.*

2.—In the "Encyclopædia Britannica," we read, under the head "Perpetual Movement," that—

Many have attempted to find a perpetual movement, but without success; and there is reason to think, from the principles of mechanics, that such a movement is impossible; for though in many cases of bodies acting upon one another, there is a gain of absolute motion, yet the gain is always equal in opposite directions, so that the quantity of direct motion is never increased.

To make a perpetual movement, it appears necessary that a certain system of bodies, of a determined number and quantity, should move in a certain space for ever, and in a certain way and manner; and for this there must be a series of actions returning in a circle, otherwise the movement will not be perpetual; so that any action by which the absolute quantity of force is increased, of which there are several sorts, must have its corresponding counter-action, by which the gain is destroyed and the quantity of force restored to its first state.

Thus, by these actions, there will never be any gain of direct force to overcome the friction and resistance of the medium, so that every motion being diminished by these resistances, they must at length languish and cease.†

3.—In Chambers's "Cyclopædia," 1738, Perpetual Motion, in mechanics, is defined—

A motion which is supplied and renewed from itself, &c., &c., &c. (See Motion.)

Infinite are the schemes, designs, &c., &c., &c. Nor does

* Rees' Cyclopædia, vol. 26, 1819.
This may have been copied from Hutton's Math. Dict., 4to., 1795.

† Encyclopædia Britannica, 18 vols., 4to., 1797.
The above is copied verbatim into the English Encyclopædia, 10 vols., 4to., 1802; art. "Movement, Perpetual."

any of them deserve particular mention, since they have all equally proved abortive. * * * *

In effect, there seems but little in nature to countenance all this assiduity, &c., &c., &c. (See Nature.)

Action and re-action are allowed to be ever equal, &c., &c. (See Resistance.)

Also see Matter and Friction; Communication and Percussion; Medium.

The multiplication of powers or forces, it is certain, avails nought; for what is gained in power is still lost in time, so that the quantity of motion still remains the same.

All mechanics cannot make a little power equal or superior to a larger; and wherever a less power is found in equilibrio with a larger, *v. gr.* 25 pounds with 100, it is a kind of deception of the sense: the equilibrium is not strictly between 100 and 25, but between 100 pounds and 25 moving, or disposed to move, four times as fast as the 100.

To consider the weights, 100 and 25, as fixed and immoveable, the 25 may seem, somehow, raised beyond themselves, which is one of the sham-miracles of mechanics, that has deceived millions, but which is easily dissipated by considering the four degrees of velocity which are to be given to the 25 pounds, and which require a force equal to the excess of 100 above 25 pounds.

A power of 10 pounds moved with ten times the velocity of the 100 pounds, would have equalled them in the like manner, and the same may be said of all the possible products equal to 100. But, in fine, there must still be 100 pounds of power on each side, what way soever they be taken, whether in the matter or the velocity.

This is an inviolable law of nature, by which nothing is left to art, but the choice of the several combinations that may produce the same effect. (See Laws of Nature.)*

4.—In Stone's "Mathematical Dictionary," we read of Perpetual Motion, that—

By this term ought to be meant an uninterrupted communication of the same degree of motion from one part of

* Cyclopædia; or, an Universal Dictionary of Arts and Sciences. By E. Chambers, F.R.S. 2 vols., folio, 1738. Vol. 2; art. "Motion, Perpetual," and "Machine."

matter to another, in a circle (or such-like curve returning into itself), so that the same quantity of matter shall return perpetually undiminished upon the first mover: and perhaps, if men had rightly understood that this is the true meaning of a perpetual motion, abundance of expence, both of money and reputation, might have been saved by the vain pretenders to this piece of impossible mechanism.

1. When a wheel, or other machine, once set in motion, will, without additional actions on it, continue to move with the same, or a greater, velocity with which it first moved, as long as the matter of which it consists remains the same; such a motion, by mechanics, is called perpetual.

2. But since bodies have not in themselves power to move themselves, and therefore have not power to increase or diminish a motion given them; if they are not acted on by other bodies, they will continue so to move, and with the same velocity: but all revolving bodies suffer friction with those by which they are suspended; and the velocities of those bodies are therefore continually lessen'd by the action of friction. Therefore, a wheel, or other machine, set in motion without additional actions on it, will not continue to move with the same velocity, tho' the matter of which it consists remains the same; but, on the contrary, this velocity will be continually diminished.

3. Moreover, since, by numberless experiments, the most polish'd or burnish'd bodies sliding over one another, lose all the motion which hath been given them, and in a short time; therefore every wheel, or any other such machine, will, in a short time, lose its motion.

4. Hence it appears, that the perpetual motion is not to be expected by a single wheel.

5. And if any contrivance causes one part of a wheel to preponderate another; whatsoever is gained by the descent of that preponderating part will be lost in its ascent; and then the wheel thus loaded, as soon as the friction hath destroyed the motion given it, will for awhile vibrate like other pedulous bodies, and then at last stand still. Consequently, no perpetual motion by wheel-work.*

* A New Mathematical Dictionary. By E. Stone, F.R.S. Second edition, 1 vol., 8vo., 1743.

5.—In a "Dictionary of Mechanical Science," we are informed that—

Perpetual Motion is that which possesses in itself the principle of motion; and consequently, since every body in nature, when in motion, once begun, would be perpetual, but for the operation of some external causes—such are those of friction, resistance, &c.; and since it is also a known principle in mechanics that no absolute power can be gained by any combination of machinery, except there being at the same time an equal gain in an opposite direction; but that, on the contrary, there must necessarily be some lost from the above causes, it follows that a perpetual motion can never take place from any purely mechanical combination; yet this is a problem which has engaged the attention of many ingenious men, from the earliest period to the present time, though it has but seldom been attempted by men of science, since the true laws of mechanics have been so well established.

An idea of a mechanical contrivance to work without intermission, till its parts are destroyed by friction [is given in an engraving of a water-wheel working a pump to supply itself]. It was supposed that the water which had fallen upon the wheel into the reservoir would be raised by means of the pump, fall through the horizontal pipe, and so produce a continued rotatory motion. Experience has, however, proved its inutility. The machine cannot furnish power enough to perpetuate its motion.*

6.—Another popular Scientific Dictionary states that—

Perpetual Motion is that which possesses within itself the principle of motion, and that of sufficient force to overcome the friction of its parts. In nature there are numerous perpetual motions, such as the revolution of the heavenly bodies, the tides, organic and inorganic changes, vital functions, &c. Artificial or mechanical perpetual motion has never yet been attained, though the subject has occupied the attention of the ingenious for many ages, the nearest approach to it being, perhaps, the dry electrical pile of De Luc.†

* Dictionary of Mechanical Science. 4to., pp. 1066. Fisher and Co. The Preface and Introduction are by "A. J. Wyke House, Middlesex, June, 1827."

† The Dictionary of Arts, Sciences, and Manufactures. By G. Francis, F.L.S. 8vo. 1842.

7.—Perpetual Motion, in Ogilvie's excellent "Imperial Dictionary," is defined as—

That which generates a power of continuing itself for ever or indefinitely, by means of mechanism or some application of the force of gravity, not yet discovered. The celebrated problem of a perpetual motion consists in the inventing of a machine which shall have the principle of its motion within itself, and numberless schemes have been proposed for its solution; but unless friction and the resistance of the air, which necessarily retard, and finally stop, the motions of machines, could be removed, a perpetual motion must be impossible from any pure mechanical combination. The problem, when strictly investigated, amounts to this—namely, to find a body which is both heavier and lighter at the same time, or to find a body which is heavier than itself. In speaking of the perpetual motion, it is to be understood that from among the forces by which motion may be produced we are to exclude not only air and water, but other agents—as heat, atmospheric changes, &c. The only admissible agents are the inertia of matter and its attractive forces, which may all be considered of the same kind as gravitation. The planets in their orbits, and in their rotations on their axes, furnish instances of perpetual motion.*

8.—In the "Dictionary of Science and Literature," by Professor Brande and Dr. Cauvin, appears the following:—

Perpetual Motion, in mechanics, a machine which, when set in motion, would continue to move for ever, or at least until destroyed by the friction of the parts, without the aid of any exterior cause. The discovery of the perpetual motion has always been a celebrated problem in mechanics, on which many ingenious, though in general ill-instructed, persons have consumed their time; but all the labour bestowed on it has proved abortive. In fact, its impossibility has been so fully demonstrated from the known laws of matter, that it is rather an insult than a praise to say of any one that he has occupied himself with the research. Nevertheless,

* The Imperial Dictionary, English, Technological, and Scientific. Edited by John Ogilvie, LL.D. Glasgow, 1854. Royal 8vo.

the pursuit of the chimera has been the cause of many useful inventions.

In speaking of the perpetual motion, it is to be understood that from among the forces by which motion may be produced we are to exclude not only air and water, but other natural agents—as heat, atmospheric changes, &c. The only admissible agents are the inertia of matter and its attractive forces, which may all be considered of the same kind as gravitation.

It is an admitted principle in philosophy, that action and re-action are equal; that when motion is communicated from one body to another, the first loses just as much as is gained by the second. But every moving body is continually retarded by two passive forces, the resistance of the air and friction. In order, therefore, that motion may be continual without diminution, one of two things is necessary,—either that it be maintained by an extra force (in which case it would cease to be what we understand by a perpetual motion); or that the resistance of the air and friction be annihilated, which is physically impossible. The motion cannot be perpetuated till these retarding forces are compensated, and they can only be compensated by an exterior force; for the force communicated to any body cannot be greater that the generating force, and this is only sufficient to continue the same quality of motion when there is no resistance. To find the perpetual motion is, therefore, a proposition equivalent to this,—to find a force (either an attractive force like that of gravitation or magnetism, or an elastic force, that of a spring, for example) greater than itself.

But it may be argued that by some arrangement or combination of mechanical powers a force may be gained equal to that which is lost in overcoming friction and atmospheric resistance. This notion at first mention appears plausible, and is, in fact, that by which most speculators have been led astray. It is, however, entirely erroneous; for by no multiplication of forces or powers by mechanical agents, can the quantity of motion be increased. Whatever is gained in power is lost in time; the quantity of motion transmitted by the machine remains unaltered.*

* The entire of the foregoing, ending at this paragraph, appears also in Appleton's Dictionary of Machines, Mechanics, Engine Work, and Engineering. New York, 1858. 2 vols., royal 8vo.

Although the perpetual motion has been demonstrated again and again to be impossible on any known principle of mechanics, projectors have not thereby been deterred from the pursuit. In 1775, the Academy of Sciences at Paris resolved not to consider or admit into their Memoirs any future proposal for the discovery of the perpetual motion; yet such appears to be the seductive nature of the subject that innumerable schemes, designs, and projects for accomplishing it have since been, and even to the present time continue to be, put forward; and there are very recent instances of men of no common attainments and reputation, and well versed, moreover, in the principles of mechanical science, who have been deceived by the ingenious frauds of charlatans and impostors into a belief of its actual discovery. Montucla, "Hist. des Math.," tome iii., p. 813; "Repertory of Arts,"* vols. vii. and xiv.; "London Journal of Arts,"† May, 1827; Airy, "Trans. of the Cambridge Phil. Soc.," vol. iii., part 2; ‡ Poppe, "Wunder der Mechanik," 1832; and various papers in the earlier volumes of the "Mémoires de l'Académie des Sciences," and the "Philosophical Transactions.") §

9.—The American Encyclopædia defines Perpetual Motion as—

A motion which is supplied and renewed from itself, without the intervention of external causes. The problem of a perpetual motion consists in the inventing of a machine which has the principle of its motion within itself; and numberless schemes have been proposed for its solution. The difficulty is, that the resistance of the air, the friction of the parts of the machine, &c., necessarily retard, and finally stop, the motions of machines, and therefore seem to render perpetual

* The "Repertory," vol. 7, refers to the Patent of Conradus Shiviers, 1790 (but should be Schwiers—see his Patent, Chapter III.), and vol. 14 to Motion from the Rising and Falling of the Tide.

† The article in the "London Journal," very flippantly written, affects to criticise the Patent of Sir William Congreve, 1827. (See Chapter XI.)

‡ Airy's paper relates to the Pendulum, and in no way to Perpetual Motion.

§ A Dictionary of Science, Literature, and Art. By W. T. Brande, F.R.S., &c., and Joseph Cauvin, M.D., &c. London, 1852. 8vo.

motion an impossibility. Attempts have recently been made to produce a *perpetuum mobile* by means of galvanism: a metallic bar being placed between two dry galvanic columns, is alternately attracted by each column.*

10.—The following is a translation of an article from a French Encyclopædia of 1765, printed in Switzerland, and has been embodied in most of our modern Encyclopædias:—

Perpetual Motion is a movement which is maintained and renewed from itself, without any external cause. Or it is an uninterrupted communication of the same degree of motion which passes from one part of matter to another. In order to find perpetual motion, a machine must be constructed having such a movement. This has been the famous problem which has exercised the minds of mathematicians for 2,000 years.

We have an infinite number of designs, figures, plans, machines, and wheels, &c., which are the fruits of the efforts made to resolve this problem. It would be useless here to give the details of any of these projects, which are scarce worth mentioning, for they have all failed. It is now more an insult than praise to say of any one that they are searching for perpetual motion. The inutility of the efforts that have been made to find it, gives a very unfavourable idea of those who occupy themselves in this research. Indeed, it appears that we dare scarcely hope to find it. Amongst the properties of matter and motion, we know of none that has the principle of such an effect.

It is agreed that the action and re-action must be equal, that one body that gives motion to another body must lose as much motion as it communicates. The resistance of the air and friction must necessarily retard that motion: thus, in order that motion may continue always, it will be necessary that it should be supplied from an exterior cause,—this would then no longer be what is required as perpetual motion; or that all resistance should be annihilated,—which is physically impossible.†

* Encyclopædia Americana, vol. 10. Philadelphia, 1854.

† Encyclopédie, ou Dictionnaire raisonné des Sciences, des Arts, et des Métiers. Par Diderot et D'Alembert. Neufchastel, 1765. Folio.

[The article concludes, referring to "Matiére et Frottemen." And under the word "Mouvement," perpetual motion is treated as "Le célébre problème;" and allusion is made to M. de la Hire's estimate of its impossibility, as it requires to find a body at the same time light and heavy; or, a body which will outweigh itself.]

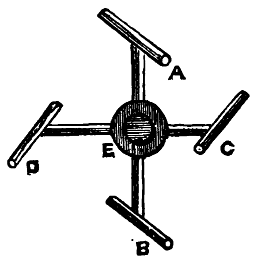
11.—In the "Encyclopédie Méthodique" will be found two articles—one, "L'Examen du Mouvement Perpétuel," which, with the diagrams, is extracted from Montucla's "Mathematical Recreations;" the second, by M. Decremps, of which we now offer an abridged translation, is as follows:—

Perpetual Motion, as proved, is but a step of the ladder of ambition to the mechanic. We will give, by way of recreation or amusement, an idea of a perpetuated movement, produced by magnetic attraction.

Mr. Wilson shows in his cabinet, at York, a compass arranged on a pivot, in the midst of a circle of iron hooks, constantly turning round by the influence of the magnetised iron hooks, each attracting the needle in its turn. It was considered a trick, really effected by concealed clockwork.

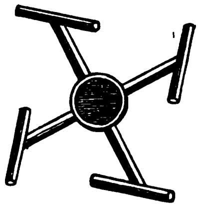
Mr. Wilson showed another experiment, consisting of two cross pieces of wood on a pivot, placed vertically, each having at its extremity inclined cases, or sheaths, containing balls of lead (see Fig. 4, plate 3). He says it is as simple as ingenious: it is attached by string. The balls A and B are in equilibrium, because they are at an equal distance from the vertical line passing through the centre E: by the construction of the machine the ball D, being, on the contrary, farther from the centre than the ball C, ought to overweigh this last one, and overcome the equilibrium, descend to the point B, and cause the machine to make a quarter turn, and so on until worn out.

(*Fig.* 4.)



To prove the falsity of the experiment, we see that the Ball D (Fig. 5), being farther from the centre than the ball C, tends to carry it round; but the ball B, which at the same moment is farther from the centre than the ball A, tends to reverse the motion. These opposite efforts must then stop the machine. Mr. Wilson admitted this statement, and said the arms were magnetised, and the stand contained a hidden magnet, and was so artfully contrived as to be capable of easily deceiving.*

(*Fig.* 5.)



12.—The following is from Zedler's "Great Universal Lexicon of all Knowledge and Art," Leipsic and Halle, 1741:—

Perpetual Motion, in mechanics, is the name given to the extraordinary movement of a machine possessing within itself its own power of motion, and so it would deserve to be called if it would last as long as the materials used in its construction. But, as a necessary consequence, it must act independent of outward power, and possess within itself the power of movement. Many persons have, from ancient times to the present day, sought to obtain this object, with great trouble and at much expence. Gaspar Schottus has described many rare examples in his "Technica Curiosa," lib. x., P. i., p. 732. But there is a larger collection of these examples by Francisco Tertio de Lanis, in his "Magisterio Naturæ et Artis," tom. i., lib. viii., c. 2 and 3; also L. C. Sturm, in "Mathesi," P. ii., p. 366. For, although the search seemed to be given up, and the pursuit was much ridiculed by Bonajustus Lorini, in his work, lib. v., c. 19, who considers it an enquiry beneath the attention of any learned mathematician, and that the finding of it would be less a mental

* Dictionnaire Encyclopédique des Amusemens des Sciences Mathématiques et Physiques. Part — of the Encyclopédie Méthodique. Paris, 1792. 4to.

investigation than an accidental discovery, besides that the loss of power by friction alone would exclude obtaining an exact calculation, many other circumstances concur to increase the difficulty. The complicated construction of most machinery conceals the truth as regards defects; it depends on a mere matter of chance to discover it. Simon Stevinus, in his "Element. Static.," lib. i., prop. 19, p. 448, gives a demonstration of the balance, in which he clearly proves that this movement is quite impossible. After him, we have Leibnitz, who has examined plans, and shows that machines of this kind must cease movement; and says, whoever wishes to follow this pursuit must be thoroughly versed in mechanics, so as to be prepared for, and provided against, every obstruction as it occurs.

In 1730, Schlüter, an eminent engineer, received an offer of 30,000 roubles from the King if he, or any other, would find out perpetual motion; but, in consequence of his decease, his son renewed the offer, but without avail. In 1712, Herr Orffyreus, celebrated in mathematics and mechanics, made a great sensation, having, after ten years' study and industry, perfected a perpetual motion; the first model of it was 2½ Leipsic yards in diameter and 4 inches deep; it raised some pounds. He then exhibited it at Court, before the nobility and people of high standing, and some celebrated mathematicians and mechanics. He showed it in several places, and was much censured for its smallness, his critics declaring that a larger one would not go. He, therefore, constructed a large machine in 1713, which was nearly 5 Leipsic yards high and 6 inches thick, revolving at the rate of fifty revolutions per minute, and raised a weight of 40 pounds. This he exhibited openly before persons of all classes. He next went to Merseburg, where he constructed a third machine, 6 Leipsic yards high (and one schuh thick). No outward cause of motion was observable, although examined by various artizans and others capable of judging; it could be moved by the finger, and had a strong inward power of its own. Being much persecuted by censures, he challenged an open trial, which occurred October 31, 1715, before commissioners, a prince, duke, several members of the nobility and learned societies, all of whom signed a certificate to the effect that they had seen it turn both right and left, on the slightest impulse, soon

acquiring a regular, rapid movement. It was published, with two others, at Leipsic, 1715, entitled—" Advice to Students on the Orffyrean System; the happy discoverer of the Perpetual Motion." His opponents continued numerous and violent, one laying a large wager that no such power existed.

In 1716, Christian Wagner, a great mathematician, in Leipsic, published—" The now fully discovered Perpetual Motion," in which he shows that, through the experiments of Orffyreus, he has made his own discoveries. He constructed a copper machine, which turned right and left with amazing rapidity, lifting a weight of 70 pounds; and this he exhibited in Leipsic.

One of Orffyreus's opponents, J. G. Borlach, of Dresden, wrote, in 1716, " Advice against Perpetual Motion."

Jacob A. Mahn, who was first a confectioner and then a clockmaker, professed to have been anticipated in the invention by Orffyreus, being himself short of means, and published his complaint in the newspapers of 1717. This, and other like representations, have not damaged Orffyreus's reputation of being the happy possessor of the secret of this wonderful discovery.

We next hear of Orffyreus being at Cassel, where he filled the office of Councillor of Commerce. He there constructed another machine, and then put forth the following advertisement:—" Fresh news of the curious and well-confirmed perpetual motion trial of Herr Orffyreus, which he now exhibits in a newly-built machine at Weissen-stein, near Cassel. From November, 1717, until the present year, 1718, it has moved perpetually during eight weeks. It is under the lock and seal of the Landgrave of Hesse Cassel. All who doubt are invited to inspect it. And, moreover, a wager of 10,000 reichs-thaler is offered for any one to accept." The diameter of this wheel was 12 schuhe, and 2½ schuhe thick; the axle-tree was 6 schuhe long, and 8 zoll (inches) thick. It was made of oak; it turned either way, commencing by a slow movement, which went on increasing. It had power to raise a large heavy box, full of stones; and this power was so evident as to dissipate all doubts of its genuineness. The Landgrave signed a certificate, speaking of the merits of the invention in unqualified terms of commendation. It was expected it could be employed for various practical operations, as mill-work and raising water; particularly by

Prince Charles (the Landgrave), who was well versed in both mathematics and mechanics, and had given much time and attention to the study of perpetual motion. Orffyreus, on his part, required a special protection, which the Landgrave refused; this became a cause of dispute, the particulars of which appear in Bresslauer's "History of Nature and Medicine."

Gärtner, of Poland, made an Archimedean screw, and a machine working by means of balls or weights, a full account of which is given in the "Séjour de Paris." He went to Paris and produced another machine, also worked by balls; but of these inventions we have only his own account. On his return to Germany, he made a whet-stone or grindstone, worked by a perpetual movement, turning right or left, quick or slow, and moveable from place to place. The King of Poland invited him to his Court, and enquired whether the power could be applied to carry on great works, of which Gärtner expressed his opinion of its inapplicability on so large a scale. Gärtner* has published numerous learned papers on this subject, many of which will be found in Bresslauer's work, already named.†

13.—In the "Allgemeine Encyclopädie, von M. H. E. Meier," of 1842, is an article by Hankel, on Perpetual Motion. He classes this motion as—

First, Physical; and, secondly, Mechanical. To the first belong the barometer and the magnet; and to the second (generally understood), a machine which not only has a self-moving power of its own, but is capable of renewing and keeping up its own motion without any outward help; or, again, one part of a machine following another in a rotation or a circle, so that the part carried round should return to its first position without having lost any of its pristine power. Kaspar Schottus's "Technica Curiosa" refers to several machines, and we find many more described by Franziskus

* In Meier's Encyclopædia, of 1842, is a statement of the discovery of Gärtner's plan being a deception.

† J. H. Zedler's Great Universal Lexicon. Leipsic and Halle, 1741. Folio.

de Lanis, in his "Magisterium Naturæ et Artis." In numbers of the "Journal des Savans" for 1678, 1686, 1700, 1726, and 1745, are accounts of many machines which are said to have succeeded in attaining and retaining perpetual motion. But Papinus appears to have written most favourably* on this subject in the "Phil. Trans.," xv. and xvi., and "Acta Erud.," 1688 and 1689. We have also, on this matter, Desaguliers, in "Phil. Trans.," xxxi.; C. L. Sturm, in "Math.," part ii., p. 366; Bonajustus Lorini, in "Festungsbau," lib. v., c. 19; Simon Stevinus, in "Element. Static.," lib. i., prop. 19; Parent, in "Mém. de l'Acad.," Paris, 1700, p. 159. La Hire, in "Mém. de l'Acad.," x., p. 426, expresses himself quite against it; which feeling may be earlier traced in the correspondence of Corn. Drebbel von Peiresc to his friend Camden ("G. Camdeni Epistolæ," Londini, 1691, pp. 333, 387), and also in Kepler ("Epistol.," 1718, p. 393). Chr. Wolff, in his "Math. Lexic.," Leipsic, 1716, is favourable to the possibility of a perpetual motion. Diez describes, in 1722, a machine he constructed on the system of Orffyreus's plan, but treats of the incompleteness of that and all others that had appeared. The Academy of Paris, in 1775, passed a resolution not to consider any plans intended for perpetual motion; at the same time appeared a paper from Carnot ("Principes fondamentaux de l'équilibre et du mouvement," Par., 1803, sec. 281). T. Young ("Lec. on Nat. Phil.," tom. i., p. 91), and others, although they have written against it—but persons, mostly of uncultivated minds—still hope to find out this movement.

In 1712, a certain Orffyreus, named Bessler, of Saxony, after ten years hard striving, professed to have found perpetual motion, being then in Gera. He made a second larger machine at Draschwitz, in 1713. A third still larger wheel was made in Merseburg: it lifted 70 lbs. from the court-yard up to the roof of the house he occupied. A fourth and larger wheel was erected by him at the desire of Landgrave Karl von Hessen-Cassel, at his castle of Weissen-stein, where it was in a sealed room, and found in eight weeks to be in the same good movement. He was strenuously opposed by the mechanic Gärtner, of Dresden, and Barloch, who declared his discovery to be an imposition. Gärtner finished a machine,

* See Chapter IV. for Papin's real sentiments.

or wheel, with weights, intended to perpetually move a clock, artfully constructed and beautifully worked: it stood on a raised stand or pedestal, under which, after some months, was discovered a hidden clockwork, by which the wheel was turned. It was made under the patronage of King Augustus II. of Poland.

None of the foreign inventors have as yet found out a machine that without some outward help will continue in motion. These machines are all complicated, instead of adopting the most simple construction, and their inventors seem not properly to understand the principles of the lever. Descriptions of such machines will be found in a dissertation of Diez, also in one by Neumann (Lubeck, 1767).*

14.—Dr. Binder, in his "Conversations Lexicon," published at Regensburg, 1848, says:—

What is understood by perpetual motion is a self-moving machine, unaided by any outward appliance. Such motion is impossible, acted on as it must be by friction and other counteracting causes. The necessary loss of power must be apparent, because of the impulsive power being derived at the expense of any surplus power that might appear to be gained, for the operation cannot be greater than the cause. It has been a study and paradox for many ages. There are the clocks of Cox, La Paute, and others; the celebrated Merseburge machine, Castelli's wheel, the wonderful weight-moving machine of Conrad Schwiers.† There was also Geisser's wheel, but of which, in 1832, after his death, appeared a description in Poppe's "Wunder der Mechanik," showing it contained concealed clockwork.

15.—The following short article, in Latin, is derived from Hoffmann's Lexicon of 1698:—

Perpetui Motus specimen, exhibetur ab Athanasio Kirchero, in hydraulica machina, seu clepsydra, quæ, ubi effluxit inversa, iterum fluit obversa, cœlum aquarum aspergine irrorans, uti-

* M. H. E. Meier's Allgemeine Encyklopädie. 'Leipsic, 1842. Fol.

† See his Patent in Chapter III., date 1790.

docet in "Descript. Musæi Kircheriani," Georg. de Sepibus, p. 3. Idem aliô quoque instrumentô utcunque eum adumbrat. In co namque motu rarefactionis & condensationis, ex metu vacui sublata aut depressa aqua, quæ in exteriore canali detinetur; cum desuper levigato corpore innatante, per annexam chordam, quæ circa cylindrum convoluta, suberis levissimi innatantis super aquam pondere in exteriore circulo per axim indice instructam vel horas vel humidum & siccum demonstrat. Sic ex quibusdam puteis, qui ad diversa anni tempora aquâ plus minusve repletur, fieri potest thermometrum, quod continuô motu quatuor distinguat; quinimô ad certa distincta spatia sonô campanulæ graduum aut anni mutatum tempus sonorô strepitu accidisse commoveat; sicque in sphæra vitrea caloris & frigoris gradus distinguantur. (Vide Georg. de Sepibus in "Musæo Kircheriano," p. 53, & suprà Mobile Perpetuum.)*

There is a large amount of repetition in this chapter, and which it has been difficult to avoid increasing. Sufficient has been quoted to satisfy an impartial reader how unsatisfactorily these great channels of information have supplied matter on this one subject. The French Encyclopædias are the most defective; but the German "Conversations Lexicons" are comprehensive, and afford the greatest number of authorities; still, of these we have been obliged to omit an edition of 1836; and also Dr. Wolff, 1843; I. Meyer, 1850; and (Brockhaus) 1853 and 1856; in consequence of their striking resemblance to each other.

* Lexicon Universale. By Joh. Jacobi Hofmannus. Lugduni, Batavorum, 1698. Folio.

CHAPTER VIII.

EARLY POPULAR AND OTHER JOURNALS, AND THE PERCY ANECDOTES.

WE shall commence with papers from the "London Magazine," the "Imperial Magazine," and the "Pamphleteer."

The absurdity of a Perpetual Motion is demonstrated as follows in the "London Magazine," vol. 17, 1749 :—

As a perpetual motion, according to the opinion of some gentlemen, seems to be comprehended within the sphere of human attainments, I humbly present these lines to the publick, to caution such against vain and fruitless enquiries.

* * * * * * *

In researches after this unattainable solution, not thinking it requisite, in the first place, to study the natural propensity of matter, which, causing its tendency to a state of inactivity, must consequently subject it to rest, as soon as deprived of its given velocity by repeated retardations, which all bodies moving in our atmosphere, or in any other medium, are perpetually subjected to; for even the least particle, upon collision or percussion, let its direction be what it will—viz., direct, oblique, or perpendicular—bears a part in the obstruction, which is more or less in proportion to such resisting particles or powers, different degrees of magnitude, density, elasticity, non-elasticity, &c. Therefore, when the sum of the velocity, which the resisting powers have received, amounts to the momentum given their actuating body, such having thus communicated its motion to circumambient particles or powers, must again return to its natural state of rest. Perhaps this demonstration may appear more evident

by a logistical method of argument, for which reason it may be requisite to reduce the whole into a syllogism.

As, according to the laws of nature, every moving body loses its motion, and returns to a state of rest, upon meeting, in a rectilinear direction, with a resisting power equal to the momentum wherewith it moves:

And as the factum, or aggregate, of a sufficient multiplicity of minutest resisting powers (or that of the successive and perpetually resisting force of the particles of air, which all bodies moving in our atmosphere are subjected unto) amounts to any momentum how great soever:

Ergo, all moving bodies will at length lose their motion and return to their natural state of inactivity—viz., when the sum of the retardations they meet with becomes equal to the momentum of the motions first communicated.

"The Perpetual Motion Hunter" is the title of an article in the "Imperial Magazine," vol. 6, 1824:—

It gives me much pleasure (says the writer) to observe that you notice scientific subjects: you are very right in so doing, as it will not only give variety, but add considerably to the value of your very useful miscellany. It is my humble opinion that such a procedure is infinitely better than filling it with the splenetic effusions of angry minds, the ebullitions of disappointed envy, or, what is worse, dealing out large portions of scandal, and making use of personalities to wound virtuous sensibility; as is the constant practice in some similar publications.

I am now, Sir, an elderly man, and am sorry to inform you that I have lost much valuable time, and, of course, money, too, from having been infected, in the early part of my life, with the vanity of hunting after that *ignis fatuus*, called the "perpetual motion." Common report informed me that it would immortalize the name of the inventor; that by it the longitude would be discovered; and that, on this account, the British Parliament had offered a premium of ten thousand pounds for the discovery! This was something like assailing a man at all points at once: the acquirement of such prodigious fame flatters his vanity; and the "ten thousand

pounds" could be looked upon in no other light than as the reward of distinguished genius!

Under these impressions I began my career, and pursued it with an ardour which, in any other case, could not have failed to ensure me success. I read, with the greatest avidity, all the accounts of such machines I could anywhere meet with. For a short time I was amused with the ball of iron and the magnet, mentioned in Bishop Wilkins' "Mathematical Magic." I afterwards studied the properties of Orffyreus's wheel, which, as Gravesande informs us, continued in rapid motion for two months; at the end of which period it was stopped, he says, to prevent the wear of the materials. This astonishing wheel was, you know, destroyed by the inventor soon after the time of the above-mentioned experiment. I endeavoured, with all my might, to recover the long-lost secret, and success partly crowned my efforts; for, after a great deal of wearisome labour, I constructed a machine which I then believed would amply compensate the loss which the crazy philosopher had occasioned, when, in a fit of frenzy, he dashed it to pieces. The delight which Newton felt on discovering the law of universal gravitation did not exceed mine when I found that my machine would answer the intended purpose. 'Tis true, it would not put itself in motion—but what then? It was sufficient for the purpose, if it would move perpetually when put in motion; and at that time, like many others, I did not quite understand how many requisites were necessary in order that a machine might become a "perpetual motion."

You can scarcely imagine how my heart palpitated when I sent off a description of this, my first invention, to the Board of Longitude: it was a machine which I had no doubt would determine the longitude, both at sea and land, with the greatest ease and accuracy. During the first week, my nightly slumbers were frequently broken by the violent perturbations of my mind; and my day-dreams almost continually represented to me the postman knocking at my door with the wished-for letter that was to crown all my hopes. So certain was I of success, that I actually began to look about for an estate which the ten thousand pounds were to purchase; for, in my mind's eye, I had it already in my grasp. The humble occupation I had till then followed, I now looked upon with disgust; and I saw myself at once elevated to opulence and

fame. I waited with patience—yes, Mr. Editor, with all the patience I could muster—but no letter arrived. However,

> "Day presses on the heels of day,
> And moons increase to their decay."

After a few weeks, my mind recovered its wonted serenity; and in about three months more, my machine was as free from any violent perturbations as my mind, for, at the end of that period, it had completely lost all power, either of perpetuating or continuing its motion. This circumstance occasioned me some uneasiness; and I was not much amused with the taunting remark of one of my friends, who, on viewing it, exclaimed, "Well! it is a perpetual motion *still!*" At the end of nine months, I received a letter from the Secretary of the Board of Longitude, informing me of what I already knew—viz., that my machine would not answer.

It is now carefully stowed in my brother Jonathan's garret, at Brigg, in Lincolnshire, where it may be seen by all who are curious in such matters.

I now turned my mind into a different channel. I thought it possible that the object of my search might be accomplished by means of some of the fluids. I considered, with care, the almost continued oscillation of the mercury in the tube of the barometer; but I could deduce from this motion no practical result. I afterwards endeavoured to turn the tides to some account; but I failed here also. At length, after turning my mind in a variety of ways, as I was one day reading an account of the rise of water in capillary tubes, it at once occurred to me that, as the water rises in such a tube to more than an inch above the surface of the water in the vessel in which the tube is immersed, if I placed the tube in an inclined position, the water would run over its top; and as it would fall into the same vessel, the motion thus produced would be perpetual. At this moment my mind was again agitated: I exclaimed, like Pythagoras, "I have found it! I have found it!" I now supposed myself to be as great a man as any Pythagoras that ever lived. I did not, however, run out, like him, naked into the street; but I remember the discovery was made in the winter season, when I was warmly and comfortably clothed: had it been in the summer, I cannot tell what might have happened.

I soon procured a capillary tube, and proceeded very care-

fully to make the experiment; but the water did not flow! Well, said I, this is curious; but a syphon will run: that the water does not run from the top of the tube, is owing to the pressure of the atmosphere upon it. I now ordered a capillary syphon; and was again disappointed, for the sluggish water, as if envious of my fame, still refused to move.*

Having recovered a little from the stupor into which I had been thrown by the failure of another of my schemes, it occurred to me that if I employed a syphon to carry water over the bank of a river that communicated with the sea, the syphon would run if the outer leg on the outside of the bank was longer than the inner leg; and because the water would find its way into the ocean, and be brought back by the process of evaporation, which is constantly going on, the motion would be perpetual. I could not, however, employ this method to discover the longitude, either at sea or land, and of course I was not entitled, from this invention, to the ten thousand pounds.

Another of my machines consisted of two wheels, A and B: the wheel A had a number of buckets at equal distances round its outer rim: these buckets were so placed that they would each contain a ball of iron. Seven such balls were always on one side of the wheel A, urging it downwards; and one was in the inside of the wheel B. When the wheel A had arrived in a certain position, the lowest ball fell out of its bucket, and rolled down an inclined plane, placed for that purpose, into the interior of B; and then it rolled down another inclined plane into the top bucket of the wheel A; and so on. This machine had a very specious appearance, and was mistaken for a perpetual motion by thousands of well-informed persons. I need scarcely add that the persons I mention were ignorant of the laws of motion and the theory of mechanics. A similar machine was lately exhibited for a perpetual motion, and a great deal of money made by shewing it to the good people of New York, in North America. My last invention of this kind consisted of an iron wheel and four magnets, similar to the one exhibited some time back in

* I have since found that nearly the same account is given by Dr. Jurin, in the Appendix to Cotes' Lectures on Hydrostatics. I can assure you, however, that the experiments were actually made by me in the manner above related.

Edinburgh, and other places. As the wheel did not move uniformly, and as the power of the magnets soon began to diminish, I suspected it would ultimately fail, and abandoned it altogether. It is necessary to inform you that my modesty —or, rather, my honesty—would never permit me to exhibit any of my inventions for money, as I had always very strong grounds of suspicion that they would not answer, and my suspicions were always verified in a short time. It was only after a great number of disappointments that I began seriously to think on the subject. I at first wondered how it happened that my schemes should always prove abortive; but I soon discovered that I was entirely ignorant of the theory of mechanics. Not long after, I had also the mortification to perceive that, I had totally mistaken the specific nature of the machine which had been so long the object of my search; so that it would have been next to a miracle if I had found it. I now began, in earnest, to acquire a knowledge of the principles of natural philosophy, and I very soon found that I had begun at the wrong end of my business.

My misfortunes had created in me serious musings. Yes, said I, in all ages mankind have had some favorite object to pursue,—a something bordering on the limits of impossibility. Astrology, or the foretelling of future events, was once the grand charm that led men astray. People are fond of prying into futurity: all men are naturally delighted with what is wonderful; and what pains do they take to deceive themselves! Astrology ruled with despotic sway during the reign of ignorance; but, as knowledge advanced, the chimera retreated; and the few votaries it has now left are ranked either amongst the most ignorant or the most knavish of all the human race.

Alchemy was another favorite pursuit. To be able to transmute the baser metals into gold was certainly an object of the greatest consequence, and now the discovery would be particularly desirable. There is no doubt that it would be liberally patronized by the Ministers of State and the members of the British Senate; because, if properly managed, it would enable them to pay off the national debt, and ease the good people of England of the intolerable burden of taxation. In case of such an event taking place, what joy would be diffused throughout the whole of this great empire! The people would be wealthy, and the Ministers again able to

create places and to give pensions *ad infinitum*. But I must return to my subject. The search after the perpetual motion is of the same nature as those of astrology and alchemy: it has long amused the ignorant and deceived the credulous; but men of science, properly qualified to judge of its merits, look upon it as a nonentity, and laugh at its proselytes as deluded creatures, who are pursuing a phantom of their own creation.

I have not much hope of being able to convince those persons who are in search of this shadow of a shade, that their labours will be fruitless. I will proceed, however, to describe the machine they are endeavouring to construct. The perpetual motion is a machine which possesses within itself the principle of self-motion; and, because every body in nature, when in motion, would continue in that state, it follows that every motion, once begun, would be perpetual, if it were not acted upon by some opposing force, such as friction, the resistance of the air, &c. In order, then, to produce a perpetual motion, we have only to remove all the obstacles which oppose that motion, and it is obvious that, if we could do this, any motion whatever would be a perpetual motion. But how, let me ask, are we to get rid of these obstacles? Can the friction between two touching bodies be entirely annihilated?—or has any substance yet been found that is void of friction? Can we totally remove all the resistance of the air, which is a force continually varying? And does not the air at all times retain its impeding force? They cannot be removed, then, so long as the present laws of nature continue to exist; and who will attempt to destroy them? Besides, it is a well-known principle in mechanics, "that no power can be gained by any combination of machinery, except there be at the same time an equal gain in an opposite direction;" and must there not be some absolute loss arising from opposing forces, as friction, &c.? How, then, can a perpetual motion be found by any combination of machinery? Another necessary circumstance is, that the motion of any such machine be uniform; for, if it accelerates, it will in time become swift enough to tear itself to pieces; if it retards, it will at length stop. Now, among all the numerous forces acting on machines,—forces, too, which are continually varying, according to known causes, and to the

influence of which every machine is constantly liable,—who is there so hardy as even to imagine that a machine can be constructed, the motion of which shall be constant, and uniformly the same? There is one perpetual motion, and but one,—that is, I know of but one,—and that was constructed by Infinite Wisdom. The Divine Creator of the universe has balanced this earth with such exquisite art, that its diurnal revolutions are performed so precisely in the same time, that it has not varied the hundredth part of a second since the time of Hipparchus, which is now more than two thousand years.

All that we can hope is, that the beams of science will diffuse truth more generally through the world; for, otherwise, dreamers of every kind will continue to dream to the end of time.

The following article appeared in an American scientific journal. The first part of it only is here taken from a reprint in the "Technological Repository," entitled—

On the futility of the attempts to construct Perpetual Motions. By Dr. Thomas P. Jones, Editor of the "Journal of the Franklin Institute."

It will not be expected, by those conversant with the inquiry, that anything really new can be offered on a subject which has been so frequently and so ably treated as the inquiry into the possibility of constructing a machine which has within itself a principle of continued motion. There is something extremely fascinating in the pursuit of this object, as is evinced not only by the attempts of a host of tyros in mechanics, but by the persevering efforts of some men of genius and science, who, although they have professed faith in the admitted laws of motion, have yet proved by their works that their faith was not perfect. Whilst there is nothing, in the known laws which govern the material world, upon which to found the idea of being able to construct a perpetual motion, the time might not be misspent which should be devoted to an investigation of the causes which operate upon the mind in exciting and keeping alive the expectation that such a machine will some day be discovered;

but if we possessed the ability fully to prosecute this investigation, it would belong more to a work devoted to moral, than to mechanical, philosophy.

Some of our readers may be ready to exclaim, "But we have understood that all philosophers denied the possibility of any such thing." We believe that all who really merit the name of mechanical philosophers do unite in such a denial; but, if this be the fact, the corps is but a small one; for our own observations, together with numerous facts upon record which might be called as evidence, go to prove most clearly that there are but few persons who admit this truth as they admit an axiom: there appears, in general, to exist some mental reservation; some apprehension that, if they declare the thing impossible, it may nevertheless happen that some lucky wight may "hit upon it," and thus ruin their reputation as accurate philosophers!

The subject of mechanics is one which, of necessity, occupies a large portion of the attention of mankind. All the moving powers which we can command are called to our aid; but into the actual employment and adaptation there enters much more of practice than of principle. A great portion of our mechanics are men of observation, intelligence, and experience; and many of them have paid praiseworthy attention to science. But their very pursuits and occupations, although greatly aided by the scientific knowledge they have acquired, forbid their carrying such investigations to a great extent. And we ought not, therefore, to be much astonished if some of them are occasionally engaged in this fruitless pursuit. To their credit, however, this is now a rare occurrence, as the observations founded upon correct practice must necessarily lead to the same general results as does a correct theory. The constant employment or notice of the various machines which are daily seen in operation, induces almost every man to conclude that he knows something of mechanics. In many of these machines, the cause of their motion is very obscure; whilst the motion itself is not only evident, but so uniform and continuous, as may well lead the ordinary mind astray, and cause the conclusion that the step from some of them to an actual perpetual motion is but a short one.

There are but few terms in our language which are less definite than the term "science;" it embraces almost every

department of human knowledge, whether natural, moral, or physical; and it happens, unfortunately, that when philosophers and men of science are mentioned, the world are not very discriminative; and the opinion of the adept in natural history, or in chemistry, will carry an undue weight in subjects to which he has not attended, and of which, although he is a man, he is nearly or completely ignorant It is in this way certainly, and in this only, that the votaries of science, and the believers in a mechanical perpetual motion, have been identified. On which side were the scientific men of Philadelphia arranged, when Redheffer's machine was exhibited at Chesnut Hill? Those who recollect the period will find no difficulty in answering the question. We believe that nineteen-twentieths of those that were so esteemed were avowed believers. We know one gentleman who professed, and was believed, to be a man of great mechanical knowledge, who delayed in completing a patent, lest Redheffer's machine should be found to be genuine. We are of opinion that there is scarcely any other subject so familiarly spoken of, and so little understood, as the principles of mechanics; and no one, therefore, in which quackery is more certain of success.

Let not our readers expect that, because we have thus freely spoken our sentiments, we are about to demonstrate that a mechanical perpetual motion is an impossibility: we should indeed be willing to take any particular machine, which might be pointed out to us as such, and undertake to show the fallacy of its claim; but to give a general negative demonstration is a task which we cannot undertake. It belongs to those who advocate its possibility, to establish a principle upon which it may be made to act; the general practice, however, has been to exhibit a complication of levers, weights, or other powers, which serve to obscure the action of the individual parts, and to claim, for the whole, effects to which these individual parts, taken alone, have no power to contribute.

It has been, we think, truly observed, that to produce a perpetual motion we must find a body which is at the same time both heavier and lighter than itself, and in which the action and re-action may consequently be unequal. This is manifestly a physical absurdity; and although many attempts have been made to cheat bodies out of the properties with

which nature has endued them, yet no one has had the hardihood to deprive them of their essence in a legitimate way.

To investigate the laws which obtain in the motion of bodies, would require a treatise of no small length: this, therefore, we cannot attempt; but, nevertheless, think it necessary to offer a few remarks upon some of them, and particularly upon the property denominated inertia, and upon momentum.

The very words which we employ to designate a particular thing are frequently permitted to lead us into error, in consequence of our not restricting our terms according to the nature of the things to which they are applied: thus, we frequently use the expression, "the power of inertia," which may lead to the conclusion that from this property of matter some power may be derived; although the very term "inertia" is intended to express the simple fact that matter is altogether inactive or powerless. Inertia is a mere nullity; and, therefore, instead of conveying the idea of power, it is intended to express the entire absence, rather than the existence, of that property. If this be true, inertia can give us no aid in producing a perpetual motion; for, supposing, for the sake of argument, that gravitation, friction, and a resisting medium, could be placed out of the question; as every single impulse which is given to matter tends to carry it on in a straight line, whatever deflected it must necessarily abstract from, and eventually stop, its motion. All our machines must have either a vibratory or a curvilinear motion, or they would, from their very structure, soon elude our grasp; any impulse which we give to them cannot, therefore, be continued, in consequence of the inertia of the matter of which they are composed. But we must also, and at every moment, encounter friction and a resisting medium; and, in consequence of these, our machine must eventually lose whatever impulse we may have given to it; for, although matter is indifferent both to rest and motion, it is not so to impulse, or, which is the same thing, to resistance; and whether we abstract from its motion by grains or by ounces, it must eventually cease. Upon this it is unnecessary to dwell, because the fact must be admitted on all hands to be as stated. But if inertia, or the absence of power, cannot give power to a machine, may we not obtain something from

momentum? Momentum is the quantity of motion, and is compounded of the quantity of the matter moved, and the velocity with which it moves. The case we have been considering under the head of inertia is a case of momentum; as we have supposed a certain impulse given to matter, which matter has, in consequence, acquired motion, and which motion, from inertia, would be continued were there no counteracting causes. If we give a double velocity to our machine, or mass of matter—as to a wheel, for example—we give a double momentum, or, what is the same thing, a double space of time, *cæteris paribus*, to exhaust this motion. We have not, therefore, advanced a single step towards perpetuity. It consequently is not in this way that aid has been sought from momentum, but one which, although it is equally fallacious, is better calculated to deceive. We have already observed that the momentum of a body is increased by increasing its velocity, or the space through which it passes in a given time, although its quantity of matter remains the same. Suppose we have a horizontal lever, or bar, with equal weights at each end of it, A and B, supported by a fulcrum between them, and that the fulcrum is but half the distance from A at which it stands from B; when allowed to move, B will therefore preponderate, and will move with a velocity which will be double that of A—that is, it will descend two inches whilst A ascends but one: its momentum power, or quantity of motion, will therefore be double. If, now, we could cause the fulcrum to change its place—that is, to bring it as near to B as it was to A, and back again alternately, each of the weights would preponderate in its turn, and a perpetual vibration would ensue. How an effect of this kind has been attempted, will be seen upon an examination of some of the plans to be presented in the sequel.

In many instances, machines have been made so complex as to render an analysis of them somewhat difficult, even to well-informed observers. This complexity, however, instead of promoting the desired end, only renders a larger portion of foreign aid necessary to produce and continue the motion.

Numerous impositions have been practised by individuals who have pretended that they had made self-moving machines. When deceptions of this sort have been practised,

the charlatans have, of course, endeavoured to perpetuate the concealment of their mode of procedure.*

[This article, which is of a very verbose character, proceeds to denounce Redheffer's machine as a deceptive one, and gives an account of "the wheel of Orffyreus," similar to that already given in the present collection. We now give in an abridged form the remaining portion of this paper, entitled—]

Observations on the attempt to construct Machines of the kind usually intended by the term of Perpetual Motion; with notices of some of the particular Machines which have at different times been proposed for the attainment of this object. By the Editor.†

Almost the only machine of the kind which has obtained any celebrity is the wheel of Orffyreus, of which an account was published by the celebrated philosopher, 's Gravesande, in 1774.

[Diagrams from Wilkins, Gravesande, and Nicholson, being described, the Editor proceeds:—]

The simplest rule that we can give, by which to perceive the fallacy of every plan depending upon the ascent and descent of weights, is, that whatever may be the weight which descends in a given time, it must raise an equal portion of matter to the same perpendicular height, in the same time, or the machine must evidently stop. Now, the power required to raise any weight to a given height is the same, provided the time be the same, whether that weight be raised vertically or obliquely. If the weights, the balls, or the mercury are to descend, they must first ascend to the necessary height; an equilibrium must therefore soon take place, should motion be produced by any extraneous force. Putting friction and a resisting medium out of the question, these machines supply no source of motion even to themselves.‡

* Gill's Technological and Microscopic Repository, vol. 6, 1830, p. 56, which appears to be the last volume published.

† Thomas P. Jones, M.D.

‡ Journal of the Franklin Institute, Philadelphia (1828), vol. 6, p. 318.

The two following articles are from the "Percy Anecdotes:"

Perpetual Motion Seeker.—Mr. Stukeley was a gentleman of fortune, bred to the law, but relinquished the profession, and retired into the country, filled with the project of discovering the perpetual motion. During a period of thirty years, he never went abroad but once, which was when he was obliged to take the oath of allegiance to King George the First; this was also the only time he changed his shirt and clothes, or shaved himself, during the whole time of his retirement.

Mr. Stukeley was at once the dirtiest and cleanliest of men, washing his hands twenty times a day, but his hands only. His family consisted of two female servants, one of whom lived in the house and the other out of it. He never had his bed made. After he relinquished the project of perpetual motion, he devoted himself to observing the works and economy of ants, and stocked the town so plentifully with that insect, that the fruits in the gardens were devoured by them. * * * * * *

The gentleman who accompanied him to the town-hall when he went to take the oath of allegiance, talked with him on every subject he could recollect, without discovering in him the least tincture of madness. He rallied himself on the perpetual motion, laughed at the folly of confining himself in-doors, and said he believed he should, some time or other, come abroad again, like other men. He was always esteemed a person of good understanding, before his shutting himself up. At the time of his death, he was building a house the walls of which were seven feet thick.—[Vol. 10. Article "Eccentricity," p. 3.]

Spence's Perpetual Motion.—Among those who have attempted the grand problem which has puzzled philosophers in all ages—the discovery of perpetual motion—few persons have displayed more ingenuity than John Spence, an untutored mechanic of Linlithgow. When only three or four years of age, Spence was excessively fond of mechanical inventions, and never could get the idea of them banished from his mind. When eleven years old, he invented and constructed a model of a loom, the whole working apparatus of

which was set in motion by a winch, or handle, at one side. It was contrived on the same principle as the looms subsequently constructed in Glasgow to be wrought by the steam-engine, but had less machinery. He gave the model to a gentleman of Stirling, and never heard what became of it. When twelve years old, he was put to the trade of a shoemaker; after only eight days' instruction, he was able to make shoes on his own account; not that he was master of the trade, but he was then left to the resources of his own ingenuity, and acquired the art without farther actual superintendence. But the natural bent of his genius leaned towards mechanics, and he never liked the employment. Wheels and levers occupied his mind from his earliest recollection, and he was happy only when he was inventing, or constructing what he had invented. He soon left his native town, and went to Glasgow, not with the view of following out the trade of a shoemaker, but in the hope of getting into an employment which would place him near some of the magnificent machines used by the manufacturers of that city. Uninstructed as an artist, however, and utterly ignorant of spinning and weaving, it was difficult for him to find a situation about a manufactory which he was fitted to fill. At last he thought himself qualified for the humble situation of the keeper of an engine; and, accordingly, engaged himself in that capacity. For two years his daily occupation was to feed the furnace and to oil the engine; and he felt happy in the employment, for it afforded him an opportunity of looking upon wheels in motion. Tired, at last, of the sameness of the scene, he returned to Linlithgow, and endeavoured to follow his original trade. But the mechanical powers still haunted his imagination, and he continued to invent and construct, till he sometimes brought upon himself the admonitions of his friends and the scoffs of his enemies, for devoting so much time to his visionary inventions, as they called them, instead of attending to his trade. The invention of the long-sought-for perpetual motion appeared to him a splendid enterprise, attractive by the difficulty which attended it, and it excited his ambition by the very obstacles which it presented. He directed his ingenuity to that object, and at length he produced a piece of mechanism of extraordinary ingenuity.

In the year 1814, he had become so disgusted with the

trade of a shoemaker, that he could continue it no longer. Often would he throw the shoe from his hand in indignation, when his mind was diving deep into the principles of mechanics, and accuse fortune for dooming him to such despicable drudgery. As often would he draw down the sage advices of his spouse, who regarded him as the dupe of a heated imagination. He now conceived the idea of becoming a weaver. He had then in view to erect looms to be worked by a water-wheel; and thus promised himself both profit and pleasure from his change of profession. Accordingly, his first object was to learn the trade of a weaver. This was soon accomplished. He constructed with his own hands the whole apparatus of a loom, except the treddles and reed; got a professional weaver to put in the first web; and, without any other instruction, made as good cloth as those regularly bred to the business. This scheme, however, was never prosecuted farther.

His last effort was to complete his discovery of a perpetual motion. The invention was known in Linlithgow a considerable time before it was known to the public; but it was despised there, in the usual way, for a prophet is not without honour, save in his own country. The voice of fame, however, at length taught the good folks that a genius was among them, and they then crowded to see it, with as much eagerness as they formerly displayed indifference about it. A considerable number of strangers also visited it, and all expressed their admiration of the ingenuity, and, at the same time, the simplicity of the contrivance.

It is difficult to convey an idea of the invention by description. A wooden beam, poised by the centre, has a piece of steel attached to one end of it, which is alternately drawn up by a piece of magnet placed above it, and down by another placed below it; and as the end of the beam approaches the magnet, either above or below, the machine interjects a non-conducting substance, which suspends the attraction of the magnet approached, and allows the other to exert its powers. Thus the end of the beam continually ascends and descends betwixt the two magnets, without ever coming into contact with either, the attractive power of each being suspended precisely at the moment of nearest approach. As the magnetic attraction is a permanently operating power, there appears to be no limit to continuance of the motion, but the

endurance of the materials of the machine. So much may be said of his model, which is rather a practical development of the principle than an application of it to any purpose.

Spence afterwards simplified the apparatus, and exhibited a horizontal wheel, set full of needles, attracted constantly round by the magnetic power; and which, he said, would move as long as the axle of the wheel would last, or the magnetic virtue remain.

Spence made several other ingenious machines, including a self-moving car, which was exhibited in Edinburgh, and on which he used frequently to make excursions along the road. This ingenious artist has very little of the enthusiastic visionary in his composition, but possesses a full reliance on his own powers. His education has been that of the operative mechanics of Scotland in general—reading, writing, and arithmetic; but he has an intuitive perception of every principle connected with mechanics, which he never studied in books; because he found, on attempting to do so, that he derived no instruction from reading, on account of not understanding the terms. He has studied mechanics, however, extensively in another way—viz., by visiting many and various machines, by observing them in motion, and by thinking on the principles developed in their construction. He cannot, however, he says, well understand a scientific description, or easily communicate his own ideas by description to others. When he has invented any particular piece of mechanism, he constructs a model of it, and thus at once satisfies his own mind on the practicability of the principles, and conveys his ideas to other minds—rather, however, for his own gratification than for any assistance he expects to obtain from it. [Article "Ingenuity."—See also Chapter IX., page 145.]

Under the title of "A few words inducing towards the discovery of Perpetual Motion, perhaps the actual discovery thereof," the following appears in the "Pamphleteer:"—

London, March, 1822.

What is meant by the term "Perpetual Motion?" Is it supposed that there is an undiscovered substance in the world, that will of itself perpetually move, with as little apparent

cause as that which actuates the needle in becoming motionless in one particular position? Or, is it to be found in the combined re-action of mechanical powers?

The first idea is stamped with a degree of probability, by the mystery of the needle; yet I imagine the latter is relied on with the greater confidence of mankind, and is the pith of the following few words:—

It is well known that the weight of a pendulum will almost regain the level from which it descended, losing a little space at every vibration, until it becomes motionless; if of itself it could exceed or even regain the level, doubtless it would become a perpetual motion.

To find a power that will aid the motion of the pendulum, and in conjunction renew its strength, is what is wanted to create perpetual motion.

What I shall endeavour to explain will at least induce towards the discovery of this power.

The principal parts of the machinery about to be shown are in number three:—

A vibrating pendulum,
A revolving pendulum, and
A tubular lever.

A vibrating pendulum in motion describes a segment of a circle, and returns on the same segment, and at every vibration its described segment decreases.

A revolving pendulum is composed of two or more pendulums, united at their lighter extremities, there revolving on an axis, the heavier extremities being placed at equal distances in the outer circle: this, I believe, is what is termed a fly-wheel when affixed to hand-mills, &c.

The tubular lever is the chief instigator of the whole, and must contain a weight apportioned to the weights of the two pendulums.

Fix the lever on a cross axis: thus, on an axis within a circle, the circle on an axis at opposite angles, thereby is given to each extremity of the lever a revolving power of motion; attach one extremity of the lever to the outer circle of a revolving pendulum, the other extremity confine within the bar of the vibrating pendulum; thus combined, the effect to be produced when put in motion will be this—

The two pendulums will guide the motion of the lever, which then partakes of the power of a pendulum, giving fresh

impulse at every vibration of the pendulum, and every half revolution of the revolving pendulum; for, as each extremity of the lever rises, the weight within falls to the opposite extremity, and gives fresh impulse to the whole: thus (if my idea is correct) will be produced motion perpetual—that is to say, perpetual so long as the materials of which it is made will hold together.

I have given this short description merely by way of example, as I believe there are several ways of combining these three powers, so as to produce perpetual motion, if my idea on the subject is correct.

The lever may contain mercury or a solid orb of heavy substance; and if the tube be exhausted of air the weight will pass more freely, and certainly increase the power of the lever.*

The two following claims occur among the many instances of alleged discovery:—

That great phænomenon, a perpetual motion, is now found out by Sir Charles le Blon, and Henry Huish, Esq., captain in the Royal navy. The mechanical part of it was performed and improved by Mr. William Paget, watchmaker, late of Burford, in the county of Oxford.—(The "London Magazine," 1756.)

Amongst the perpetual claimants of this (so far as we know) undiscovered discovery, another has arisen, who asserts that he has invented one which has not ceased for several years, and which, unencumbered by weights and springs, and such "foolery," will maintain itself as well for a century as a day: its power and velocity, he asserts, are equal to anything.—(The "Imperial Magazine," 1823.)

Mr. Gill, as chairman of the Mechanical Section of the Society of Arts, having, in Thomson's "Annals of Philosophy,"

* The Pamphleteer, vol. 21, 1822.

No. 41, Tract 8.—Considerations of the Police Report of 1816, &c. With a few words inducing towards the discovery of Perpetual Motion—perhaps the actual discovery thereof. Page 207.

1820, exposed an imposture, as already given, now, in his own Journal, has "Another pretended Perpetual Motion exposed:"—

The public are highly indebted to the spirited conduct of three respectable and scientific individuals, in suppressing a gross imposition upon the too easy credulity of the British public. The exhibition was in Fleet-street, and the admission money demanded was two shillings for each person. It has been described to us (for we had not faith enough in the practicability of the thing to wish to see it) as consisting of two upright axes; their upper and lower pivots turning in holes made through pieces of brass sufficiently thick to enclose any communicating powers from machinery placed either above or below the pivots, to intimate that no motion was conveyed to the axes through them. Upon one of the axes, two toothed wheels were fixed obliquely, which worked into a long pinion upon the other axis; and upon the upper surface of one of the toothed wheels three inclined planes were fixed, having a small waggon or carriage upon each, with weights affixed to them; and it was pretended, by the exhibitor, that these carriages, by their downward tendencies, were the real cause of the motion. This, however, was all pretence, and intended to divert the attention of the observers from the real source of motion.

We have already stated that the pivots of the upright axes passed through thick pieces of brass. And it was evident that one or other of these pieces included two toothed wheels, the one upon the pivot which passed through it, and the other upon another axis, which derived its motion from a concealed spring movement, placed either above, or, more probably, below the pivot, in the support of the machine; which spring was wound up from time to time, as its power became exhausted. One of the gentlemen offered to give the exhibitor a thousand pounds, provided he would suffer him to enclose the machine in a locked chest, and that it should be found to continue in motion one week afterwards. This he declined to accept; but, upon their assuring him of their conviction of their being possessed of the true cause of its motion, twice did he refund the money he had taken from them! They did not, however, stop here; for, after detecting the imposition themselves, they thought it their duty to

prevent the public from being farther imposed upon; and therefore they prepared a placard, and paid a person for carrying it up and down Fleet-street, to caution the public against being duped by any pretended perpetual motion. This had the effect of dislodging the proprietor from his first place of exhibition, and it was thought to have suppressed the delusion: but not so; he soon recovered from his panic, and in his new placard announced that the *real* perpetual motion was only to be seen there: he also gave out that it was his intention soon to take out a patent for it; and several gentlemen actually called upon the editor to inform him thereof. The exhibitor did not stop even there, but laid a complaint before the Lord Mayor, of the annoying conduct of the gentlemen who had detected the imposition; but his Lordship, much to his credit and to the dismay of the quack, informed him that they had acted very properly; that their conduct was highly praiseworthy; and that, had they not done it, he should have found it necessary to have taken the same measure.

We hope that we may now congratulate the public upon being freed from this imposture, which had, however, founa many believers in the possibility of the thing; and we would seriously advise all persons, in future, to inquire into the causes which actuate these pretended self-movers, and not give themselves up to the expectation that such an invention will ever be discovered.

The Society of Arts has been so very often annoyed by the claims of persons bringing pretended self-moving machines, or perpetual motions, before it, that it is about to offer a premium for the best demonstration of the utter impracticability of such a thing being ever accomplished.

The imposture of another of these charlatans, who exhibited in the Burlington Arcade, was last year detected, and soon stopped, by the editor.*

A correspondent writes Mr. Gill "On a pretended Perpetual Motion," which would appear to be the same he himself described in 1820:—

Bury St. Edmunds, Suffolk, Dec. 10, 1825

SIR,—Some few years since a person exhibited in Bury a

* The Technical Repository. By Thomas Gill. Vol. 1, 1822, p. 235.

perpetual motion, or pretended perpetual motion, of which the maintaining power was magnetism. The invention consisted of two horse-shoe magnets, fixed in a horizontal plane, with their poles opposite to each other, and a few inches apart. Between them was placed a small needle similar to that of a compass; but, instead of the cap and point suspension, it was fixed at right angles to a light perpendicular axis, and it was pretended that the powers of attraction and repulsion of the two magnets kept the needle in a perpetual and very rapid rotatory motion. Between the two poles of each magnet was fixed a small block of a black substance, which, the exhibitor asserted, was a mixture of metals possessing the power of intercepting the magnetic influence; but beyond this, he was, or pretended to be, entirely ignorant of the principle of the invention, which he stated was not the fruit of his own ingenuity, but of some person whose name I forget, and who bequeathed it to him on his death-bed. Accidentally meeting with some numbers of the "Mechanics' Magazine," a few days since, I found a description of a perpetual motion which, I have no doubt, is the very same; but there is no attempt at explaining the principle upon which it is constructed. As you have already exposed one or two impositions of this kind, perhaps you will not deem the one I have attempted to describe below your notice. If it were a perpetual motion, as many imagine, it seems deserving of consideration for its great ingenuity; and if not, a detection of the fraud may serve, in some measure, to prevent similar impositions. * *

Your obedient servant,

A. E.

Observations by the Editor.—We must own that we cannot possibly conceive what benefit can be derived from the continual publication of pretended perpetual motions! They merely serve to gratify that perverted appetite for the marvellous, which, unfortunately for true science, is always too much prevalent.*

[He concludes by mentioning the rapid movements produced by electro-magnetism.]

* The Technical Repository. By Thomas Gill. Vol. 9, 1826, p. 56.

In the "Quarterly Review" appeared an able article on "The Century of Inventions of the Marquis of Worcester, from the Original MS.; with Historical and Explanatory Notes, and a Biographical Memoir. By C. F. Partington, &c. London, 1825."

The following selections are made from the review of this work, as being pertinent to the object of the present work. As regards the "Century," the critic remarks:—

It has frequently been asserted—but on grounds too weak to warrant any such supposition—that these "Inventions" of the Marquess were mere assumptions set down at random; and that he never had by experiment performed any one of them, nor intended that they should, either by himself or others, be performed. Hume, who does not even know the title of his book, boldly pronounces it (the "Century") "a ridiculous compound of lies, chimeras, and impossibilities;" and Walpole, in his "Royal and Noble Authors," designates the Marquess as a "fantastic projector and mechanic." With his too frequent disregard of truth, he asserts what is in direct contradiction to historical fact; he was a prejudiced writer, and, like some others more celebrated for their literary attainments than for scientific knowledge, affected to despise and undervalue what he did not understand.

There are some circumstances, however, it must be confessed, which lead one to conclude that his projects were wholly disregarded at the time. The Royal Society had then been some years in existence. Sir Isaac Newton, Boyle, Wilkins, Hook, and other learned and ingenious men, were living, and eagerly pursuing philosophical researches; yet no notice appears to have been taken by any of them of the Marquess's pretensions. Could it be that the mysterious and empirical terms in which his inventions are stated caused them to be disregarded? True it is, he was poor; and it is clear, from the Act passed in his favour, that his object was, and indeed it is so expressed, "to enable his heirs, for 99 years, to receive the sole benefit, profit, and advantage resulting from his 'water-commanding engine,'"—but his poverty was greatly, if not altogether, occasioned by his father's loyalty to two sovereigns.

[The reviewer then, alluding to the Marquis's imprisonment in Ireland in Charles the First's time, and in the Tower when Charles the Second ascended the throne, ably upholds his character for both genius and piety. After a dissertation of some length on the steam engine, he proceeds to say:—

The wonderful wheel described in No. 56—which is, as the Marquess says, "a most incredible thing if not seen"—is an attempt at what has been tried by thousands, and which will yet be tried by thousands more. The failure of such a number will not deter others from wasting their time and substance to no purpose in the discovery of a perpetual motion —a property the power of which is vested solely in the Great Author of the universe, and exists only, as far as we know, in the arrangement of the planetary system. No charge of quackery, however, can fairly be laid against the Marquess on this score, as the wisest men of his time, and both before and after him, have split upon the same rock. Now at last, however, the squaring of the circle, the finding of the longitude, and the discovery of perpetual motion are the stumbling-blocks mostly of feeble minds, set in action by that dangerous thing, "a little learning."

There are a few, but not many, of the "scantlings" which may justify Lord Orford's ill-natured remark; for instance, No. 25, which runs thus:—"How to make a weight that cannot take up an hundred pounds, and yet shall take up two hundred pounds, and at the self-same distance from the centre; and so on, proportionably, to millions of pounds." This is, at least, in its present state, unintelligible. It is "paradoxical," and so completely contrary to every established principle or rule in science, that we may fairly set it down among the marvellous, contributing to bring the whole "Century" into disrepute. Mr. Partington's little volume will, however, prevent this.*

* The Quarterly Review, vol. 32, 1825, 8vo., pp. 397-410.

CHAPTER IX.

RECENT POPULAR SCIENTIFIC AND OTHER JOURNALS.

The "Mechanics' Magazine," which commenced in 1823, gave great facilities to artizans and others to communicate their views; and the following abstracts of lectures, papers, letters, and editorial notices, evidence how much this subject has been discussed in the pages of that journal. For convenience, in perusing them, they are given both in the order of their dates and arranged under the following heads:—First, all relating to the Possibility, and, secondly, those asserting the Impossibility, of Perpetual Motion; then, thirdly, Plans; fourthly, Alleged Discoveries; and, fifthly, Impostures. Two papers from American journals are appended to these in their proper places, a review of Sir William Congreve's pamphlet, and a notice relating to Hendrickson.

SECTION I.—*Its Possibility Asserted.*

T. H. Pasley (vol. 2) writes, June, 1824:—

I feel no hesitation in standing up in support of this grand desideratum—this almost forsaken friend of science,—whether the thing be practicable or not.

[Under the impression that this problem is of great value to science in general, and that there is no occasion to dishearten those who try to find it out, he says:—]

On the contrary, "Persevere" should be every one's advice; to do so, or discontinue, every one's own pleasure. And why should the impossibility of anything be pronounced unless it be established wherein the limits of possibility consist?

[He has much original reasoning, and not very *apropos*, such as—]

It is puerile in the extreme to be foretelling defeat when so many other objects may be gained by the highly laudable pursuit, perhaps of greater advantage to society at large than the discovery in question. * * * * * In a word, were the perpetual motion discovered to-morrow, it would be wise of all the governments of the world to offer a very high reward for some species of discovery that would be universally sought after, although it might never be found out. * * * * [Adding:—] The effects of industry are—enlargement of the mind, accumulation of knowledge, and rendering ourselves ignorant of the torments which idleness and dulness always engender. * * In the next place, there are no solid grounds for the assertion that the discovery of a perpetual motion is an impossibility. In the present state of human knowledge respecting the powers of nature, it is not demonstrable one way or another. * * * [And again:—] The study of what relates to the perpetual motion has this great advantage, that it directs to the discovery of error as well as of truth; whereas, what are they which are called truths of science at present but vacillating human opinions, or erroneous assumptions of what we call natural causes? What are they but such as consist in mere assumption, sanctioned by time, and admitted by existing authorities in science, and of course generally acquiesced in, without previous investigation?

[Speaking of the "stern conditions on which alone the student in science can have his opinion listened to," he says:—]

So far, then, from being guided in our decision respecting what is possible by the "unerring laws of nature," by "mathematical demonstration," and by "experimental proofs," we are continually misled by an erroneous faith in the nonentity, attraction.

[He attempts to show our acquaintance with "motion," and the "cause" wherein "continued motion consists;" then says:—]

On such an imperfect knowledge of the causes of phenomena,

who should say he knows what can or what cannot be discovered?

[He seems to think there is some "true motion-making cause" which may be employed to produce perpetual motion on some species or other of mechanism.]

A plan designed to accelerate the discovery of Perpetual Motion (vol. 4, 1825):—

[The writer remarks—"All that has or can be said will not amount to a proof of its impossibility." He then examines how, what were once thought impossibilities have of late been accomplished, as:—]

We can now, however, soar above the clouds, explore the depths of the ocean, and skim over its surface. * * And be it remembered that we owe these and many other advantages to a few persevering individuals who were, in all probability, stigmatised as chimerical visionaries by those who seem to have an unconquerable propensity to condemn everything above the level of their own understanding.

If by perpetual motion nothing more is meant than the putting in motion some of the most durable substances with which we are acquainted, in such a manner as to ensure a continuance of motion as long as those substances will resist the effects of time and friction, I do not despair of seeing it accomplished. * * [He thinks there is] reasonable ground to hope that the time is not far distant when even this impossibility must yield to persevering ingenuity. In the present state of public opinion with regard to its practicability, it would be looked upon as an empty boast, were I to assert that the discovery is already made.*

J. Welch (vol. 5, 1825) confesses himself a believer in the existence, or rather possibility of discovering, perpetual motion:—

Those who condemn the notion altogether seem to have

* The person who can raise a weight of 6 oz to the height of 13½ inches, merely by the descent of 4 oz. only 12 inches, ought to be allowed to assert that the discovery is made.

taken but a very confined view of the subject. What they say about mere matter is right enough; but they seem to forget that there are other active agents in nature which possess wonderful powers, that have nothing to do with either bulk, weight, or form. Such are electricity, magnetic attraction, capillary attraction, and the irregular pressure of the atmosphere. The powers of electricity are great, and, indeed, it seems to be the *primum mobile* that gives life and motion to the animated part of the creation. Dr. Franklin shows us how to give a circular coated plate, revolving on an axle, sufficient power to roast a chicken, merely by once changing (charging?) it. Could not a plate of this kind be made to turn a small electrical apparatus, so situated as to keep the charge in the plate always at its maximum? The whole might be kept dry by having it enclosed in a glass case.

It has often been attempted to give motion to a wheel by the power of a loadstone, but hitherto without effect; no substance in nature being found to have the power, by interposition, of cutting off its attractive property. Still I think it should be further investigated. Is a small piece of steel in the form of a wedge as strongly attracted at the smaller end as at the thicker? And would not twenty or thirty pieces of steel, of that form, placed round the circumference of a circle, the point of one towards the head of the other, cause a magnet placed in the centre, to revolve in the direction in which their points lie? I think, perhaps not; but still such experiments should be tried.

In capillary attraction we have a power that at once raises fluids above their level. It is this which carries the oil up the wick of a lamp as fast as the flame consumes it. Water and other fluids rise through cotton even quicker than oil; and he who can contrive to collect them as they arrive at the top will discover perpetual motion. Would not water run constantly through a syphon, one leg of which was made of a collection of capillary tubes, and the other in the usual way? or would the water above and below the tubes neutralise and destroy their power?

I now come to the pressure of the atmosphere, a thing easily understood. * * * * Make a cast-iron barometrical tube, with a top sufficiently large to contain 2 cwt. of mercury; invert it in a basin large enough to contain 2 or 3 cwt. more, and let a piece of iron of 10 or 12

stones weight float on the mercury in this basin, so as to rise and fall along with it at every change of the weather. We have here both motion and power. The motion, indeed, will sometimes stand still, but then it can easily be regulated, and made a constant quantity in the machine to be attached. I have no doubt but clocks, &c., may be made to derive their chiming principle from a contrivance of this nature.

H. Todd (vol. 8, 1827) says :—

* * * Many of your readers seem to have imbibed very erroneous opinions on this grand desideratum, both as regards its utility and its practicability.

First, It is supposed by many that, when it can be found, very many useful and entirely new effects will be produced. This is an error; for, if it should be discovered, no advantage of this kind would follow, as it is the regularity of motion, not the perpetuity of it, that would be advantageous or useful. Mere motion in perpetuity would be of no avail, or, at least, not worth the expense of erecting any machine to continue it in another form. The determination of the longitude, which many so fully anticipate, would be as far distant as ever. Perpetual motion can, in fact, be obtained by a common watch, by winding it regularly up (for it is perpetual if it never stops till the works are worn out); but the chronometer is no nearer perfection on that account. Some also seem to entertain an idea that a reward from the English Government awaits the discoverer of the perpetual motion. This is only imaginary, as no such reward ever was or could be offered for what would benefit no one. True it is, that the person who discovers a certain way of finding the longitude, in any or every place (chiefly on the sea), will be entitled to a reward from the Commissioners of Longitude, let that method be what it may; and as perfect regularity of motion would make a perfect chronometer in itself, such perfect regularity, if found, would be the means of obtaining the longitude, setting aside perpetuity, as of little or no consequence in the affair. Hence, the makers of chronometers turn their attention always to the perfection of the regulation part of the machine; for if a common watch, to be wound up daily, could be made to show mean time truly, it would be infinitely superior to any chronometer or

timepiece wanting regulation, though it required to be wound up once in seven years, or in one hundred years, or went perpetually without being wound up at all.

Next, as to the practicability of perpetual motion, though so many doubt it, I, with several others, not only assert that it is practicable, but that it has already been found out, or discovered, and, as appears to me, in the most satisfactory manner possible: I do not mean by mechanical powers alone, but with their assistance, conjoined with the powers of nature. We need not examine into the pretended inventions, whether patent or otherwise, of those authors who assert the discovery by mechanism alone.

[He then copies, as "the complete reason" of this, from "the celebrated B. Martin, in his 'Philosophical Grammar,' p. 125."]

The incredulous on this head, though zealous in the cause, have nevertheless pursued their desires this way; and the Patent Office at Washington, in the United States of America, is adorned with models patented as perpetual motions, but standing there *motionless* as the models of all the other patents about them.

[After describing the wheel by Dr. Shiviers,* he says:—]

Of this, nothing more was heard of (as I can find) from the time of its discovery or publication; but this does by no means forbid the employment of mechanics united with other means. There are several parts of nature which of themselves are perpetual motion, and require only mechanics to regulate them. First, there is the rise and fall of the tides; second, the waves of the sea; third, the wind; fourth, the variation of weight of the atmosphere; fifth, electricity; sixth, expansion and contraction, by heat and cold, &c., &c.; nor does the art appear so much in applying them to machines, as the regulating the motions when so applied. Of the practicability, however, there can be no doubt. By perpetual motion, as it is generally understood, I mean a machine once set in motion, that will go without any further human assistance till the works are worn out by time or its materials

* Read—Schwiers.

decay. Now, this, I again repeat, has already been accomplished, and that by a Mr. Coxe, a celebrated mechanist, and, I believe, maker of various other automata, as to have a museum formed of them. As this was exhibited to the public, about the middle of the last century, for several years, it must have been generally known at that time. (I think this was the most celebrated of his works.) The only account I can at this time give of it is this:—it was a watch, capped, jewelled, and protected from friction in every part as much as possible; without any main-spring, the inventor so applied it to the mercury in a barometer attached to it, that the rise and fall of the mercury gave motion to the timepiece or watch; and the best part of the invention was, that if the barometer were taken away, the timepiece would go a year without it,—if applied, the power would continue it; and it had a contained self-regulator, to let off or adjust all excess of power caused by the rise and fall of the barometer.

[He begs some reader to forward an account of it, and adds:—]

I do not know whether Coxe's Museum was exhibited before or after Martin's Museum, which I believe also consisted of automata.

Thus was perpetual motion discovered,—for such it was in every sense of the word; and that it is feasible in other ways, I think no one can doubt. The chief ingenuity in Mr. Coxe was in applying the perpendicular difference of height in the column, caused by the variations of the atmosphere's weight, with a self-regulator. I do not recollect whether it was regulated to that perfection as to keep to mean time: its being perpetual motion did not of necessity imply this, though, perhaps, it came as near it as any other chronometer on the steel-spring construction.

[He says:—"The engraving showed, chiefly, the front view."]

The waves of the sea could certainly be applied to produce a regulated perpetual motion; and I have read somewhere, though my memory at this instant does not assist me in particulars, that a Frenchman had made a mill or some machine to be wrought by the waves only. I think it is related

in some of their Society Transactions. The rise and fall of the tides would also make a constancy or perpetuity of motion, wanting a self-regulator. There are tide-mills on the Thames and other places. And I now hear that a Frenchman has invented a timepiece set in motion by the wind, which, on the principle of Coxe's barometer-watch above-mentioned, probably has sufficient wind in any one week, or month, to supply it for a year, and a kind of self-adjusting escape to let off the surplus power; and which is to all intents and purposes actual perpetual motion. I might refer to many other things, more curious than useful, causing differences by themselves; as of contraction and expansion by cold and heat—accumulation and exhaustion, as by rain and evaporation, as to a variety of natural causes; any of which, if the necessary self-regulating mechanism were applied, would perform a similar continuity of action, and which would as certainly be perpetual motion, though of no use. For the winding up of a clock, as a prime mover, can be regulated much easier than any other machine yet known. Metals are found to expand every way, but wood only in the width of the fibre; hence, a wooden pendulum has not yet been found, I believe, to expand only across the grain (which is of no consequence), and not in length.

[He concludes with advising "not to attempt perpetual motion *alone;* next, that perpetual motion, of itself, is of little or no use unless it can be duly or properly regulated; and that a regulation of any of the present known powers will be of more service than perpetual motion itself, when alone found."]

* * * * * *

I remain, your constant reader,
H. TODD.

REVIEW OF PAPERS ON PERPETUAL MOTION (vol. 11, 1829). By an anonymous correspondent:—

[His review is necessarily abridged, and is only given in consequence of its author professing to be a practical mechanic of some experience.]

To begin, then, I boldly affirm that to be possible which is

now universally denied to be so—namely, perpetual motion by mechanism. * * * Having made this bold assertion, I shall proceed to make some remarks on what has been said to the contrary.

[He commences with vol. 4, and notices the several schemes therein. Also Emerson's Proposition 118, Corollary.]

I believe it was Emerson's idea, and I conceive it to be a general one, that if a body, or a system of bodies, could be made to revolve on an infinitely small axis, or a point of suspension placed in its centre of gravity, without any friction whatever, and that the body or system were put in motion in an unresisting medium, that motion would be continued by its *vis inertia*, even when that motion proceeded from a momentary impulse; but as the effect of friction and the resisting medium is, in practical mechanism, an insurmountable obstacle, his corollary holds good thus far, and no farther.

[After noticing the Finch Lane imposition, Philo-Montis, and T. Bell, he states:—]

I have looked into Dr. Hutton's "Mathematical Recreations," referred to by T. B. Dr. Hutton generally observes:—"The perpetual motion has been the quicksands of mechanicians, as the quadrature of a circle, the trisection of an angle, &c., has been that of the geometricians; and as those who pretend to have discovered the solution of the latter problem are persons scarcely acquainted with geometry, those who search for the perpetual motion are always men to whom the most certain and invariable truths in mechanics are unknown."

[He does not like the style here adopted, saying:—"It falls heavy on smatterers—a character I never professed to exceed."]

Dr. H. goes on to observe (and it will be necessary to dissect his arguments, to get at his meaning):—"It may be demonstrated to all capable of reasoning in a sound manner on those sciences, that a perpetual motion is impossible." How? Why, "it is necessary the effect should become the cause, and the cause the effect." Assertion to prove assertion. Perhaps it is necessary—perhaps not; but then we

have an example:—"A weight raised to a certain height by another weight, should, in its turn, raise the second weight to the height from which it descended." Be it so; still, it does not follow that this is necessary to perpetual motion. "According to the laws of motion, all that a descending weight can do, in the most perfect machine the mind of man can conceive, is to raise another weight in the same time to a height proportioned to its mass"—that is, by the most perfect machine the mind of man can conceive; so that the argument comes to this:—human ingenuity has not hitherto been able to go beyond this point, which is necessary to produce perpetual motion. But, whether it is necessary or no, the Doctor extends it to this:—it is impossible to produce perpetual motion by any means the mind of man can conceive; so that the Doctor, it seems, has made a discovery equal, perhaps, to the one in question—namely, a knowledge of the utmost extent of the energies of the mind of man! But he has not yet drawn his conclusion, as he goes on to explain why a machine cannot continue its motion when acted on by equal weights on each side the centre of motion (as I assume his arguments are confined to that view of the question); and he evidently falls into the common error before noticed, of applying his maxima beyond their sphere of applicability, building his argument on the corollary of Emerson's, already alluded to.

* * * * * *

[After alluding to the schemes of "T. B.," "P.," and "H. Todd," he goes on to say:—]

I have mentioned these three schemes together, introductory to an inquiry I wish to make respecting a principle which I conceive they embrace. Their projectors seem to have assumed that if two equal weights be placed at the end of a lever or balance of unequal arms, and be made to move on a centre or axis, the descending weight always moving in the circumference of a circle whose radius is equal to the longest arm, then, if by any means the ascending weight could be carried up through the perpendicular diameter, or near to it, by the action of the lever, the descending weight would always preponderate after it had once left its perpendicular direction, and the equilibrium which would take

place at the perpendicular be destroyed by a succession of similar levers and weights. I ask, would this be the case? I am aware of arguments that may be used to show that there would be no more than an equilibrium when the actions of the different levers are combined at equal distances from one another, and the weights made to preserve an uniformity in their angular velocity; but if those arguments are no other than what I can anticipate, I have doubts of their applicability. I will venture to ask two questions:—The first is: What is the difference, or is there any, in the effective force or the momentum of a weight falling through the perpendicular diameter of a circle, and of the same or an equal weight falling through the semi-circumference of the same circle, at the end of a lever moving freely on the centre, without any counterpoise? The second is: What am I to understand by the expression, "The cycloid is the curve of swiftest descent; or a heavy weight will fall from one given point to another, by the way of the arc of a cycloid, in a less time than by any other route?" and does it admit that these points may be perpendicular to a horizontal line?

* * * * * *

Now comes our champion, Sir Wm. Congreve, of whose plan I shall say but little; it meets my ideas in almost every point.

[After commenting on the Baronet's plan, he adds:—]

As to the words that, in mechanical operations, "no duty can be performed without a correspondent loss of efficiency," though they may be the words of one of our most celebrated mathematicians, I cannot help being so uncourteous as to say * * * they "are not worth a rush." No one can have more respect for men who excel in scientific pursuits than myself—they are to me as demigods; but when I look up to them for instruction, and receive it in unintelligible language, I cannot help lamenting the infatuation that should induce them to throw a veil over scientific subjects, as though they were (like some others) thoughts too sacred for the eye or the ear of the multitude; and, by this means, when they would wish to convey information, run the risk of proving the maxim in a literal sense—perform a duty with a corresponding loss of efficiency.

[He proceeds to notice other schemes, and then gives the following :—]

Proposition.—In what way may a body, or rather a system of bodies, be impelled or made to move on an horizontal plane by the force of pressure alone, the source of pressure being within the system, or the first mover being a weight, or weights, forming a part thereof?

I do not presume to say that such a thing is possible, though I have dreamt such a conclusion may be drawn from the composition and resolution of forces. I should like to see a demonstration of the contrary. If this proposition is a possibility, perpetual motion easily follows.

When a subject is involved in uncertainty, the greater the number of opinions that are taken on it the more likely is the system to be unravelled; even though many of those opinions may be in the greatest part erroneous, still, they tend to place the subject considered in so many different points of view as to add materially to the facility of its investigation.

[On Mr. Nicholson's remark that he has "met with no clear enunciation of this project so general as to include every possible scheme," he says :—]

Certainly not; nor will any one else, until every possible scheme be produced, which is not likely to be very soon the case.

[He has been speaking of the "want of direct and concise demonstrations of the fundamental principles of the lever, &c." Then comes an extract "from a short essay in a scarce volume of tracts, by H. Hamilton, D.D., F.R.S., and Professor of Philosophy in the University of Dublin. He says :"—]

"The many useful instruments that have been so ingeniously invented and so successfully executed, and the great perfection to which the mechanic arts are now arrived, would incline one to think that the true principles on which the efficacy and operations of the several machines depend must long since have been accurately explained; but this is by no means a necessary inference, for, however men may differ in their opinions about the true method of accounting

for the effects of the several machines, yet the practical principles of mechanics are so perfectly known by experience and observation, that the artist is thereby enabled to contrive and adjust the movements of his engines with as much certainty and success as he could do were he thoroughly acquainted with the laws of motion, from which the principles may be ultimately derived. However, though an inquiry into the true method of deducing the practical principles of mechanics from the laws of motion should not contribute much to promote the progress of the mechanic arts, yet it is an inquiry in itself useful, and in some measure necessary; for, since late authors have used very different methods of treating this subject, it may be supposed that no one method has been looked on as satisfactory and unexceptionable. The most noted theorem in mathematics is this: 'When two heavy bodies counterpoise each other by means of any machine, and are then made to move together, the quantities of motion with which one descends and the other ascends perpendicularly will be equal.' An equilibrium always accompanying this equality of motion bears such a resemblance to the case where two moving bodies stop each other when they meet together with equal quantities of motion, that many writers have thought that the cause of an equilibrium in the several machines may be immediately assigned by saying that since one body always loses as much motion as it communicates to another, two heavy bodies counteracting each other must continue at rest, when they are so circumstanced that one cannot descend without causing the other to ascend at the same time, and with the same quantity of motion; for then, should one of them begin to descend, it must instantly lose its whole motion by communicating it to the other. This argument, however plausible it may seem, I think is by no means satisfactory; for when we say that one body communicates its motion to another, we must necessarily suppose the motion to exist first in the one and then in the other; the descending body cannot be said to communicate its motion to the other, and thereby make it ascend; but whatever, we should suppose, causes one body to descend, must be also the immediate cause of the other's ascending, since, from the connexion of the bodies, it must act on them both together, as if they were really but one. And, therefore, without contradicting the laws of

motion, I might suppose the superior weight of the heavier body, which is in itself more than able to sustain the lighter, would overcome the lighter, and cause it to ascend with the same quantity of motion with which the heavier descends, especially as both their motions taken together may be less than what the difference of the weights, which is here supposed to be the moving force, would be able to produce in a body falling freely. However, as the theorem above mentioned is a very elegant one, it certainly ought to be taken notice of in every treatise on mechanics, and may serve as a very good index of an equilibrium in all machines; but I do not think that we can from thence, or from any one general principle, explain the nature and effects of all the mechanic powers in a satisfactory manner, because some of these machines differ very much from others in their structures, and the true reason of the efficacy of each of them is best derived from its particular structure."

As these remarks perfectly agree with my own ideas on this subject, I may be allowed to draw this conclusion, that from hence it follows it may be possible to construct a machine whose effects are not to be easily or satisfactorily explained on any one general principle; and that, after all, experience must take place of theory.

[Of the wind, the tides, &c., he remarks:—" as I before observed, are an approximation, but not a solution, of the problem."]

In vol. 12 (1829-30) appears the annexed communication:—

The following is an extract from the letter of an esteemed correspondent, to whom our readers have been indebted for many valuable contributions to our pages:—

I now send you a copy of a memorandum I have placed among a great number of papers, diagrams, notes, &c., on the subject of perpetual motion, but all unintelligible to any one but myself. "Infatuation all," you will say; but though I might not be able to deny this charge *in toto*, yet this I will say, I can demonstrate the possibility of perpetual motion by the action of material bodies on one another, aided by the con-

stantly existing powers of nature, made available to that purpose. The memorandum is as follows:—

Query—What ought to be the reward for the invention of a continual self-acting power which may be increased at pleasure and without limitation, excepting that of the strength of materials acted upon by their own weight? That this is possible and practicable I am now convinced, and that there is no law of nature or even theorem in the science of mechanics which goes to controvert the assertion. But the principles on which it may be effected, and particularly the practical means, have hitherto eluded the researches of the ingenious of all ages to the present hour, and now lie concealed in the breast of an individual who may possibly, from neglect and want of encouragement, be induced to relinquish a pursuit the developement of which would confer an incalculable benefit on mankind, and the loss of which may require ages yet to come to recover.

That the above is the unequivocal and sincere opinion of the writer is attested by his own hand this 25th of February, 1829.

In vol. 13 (1830) there is a conditional engagement to construct twenty models:—

The submitter of the following proposals having, for some years, been prepossessed with an idea of being able to invent a self-moving machine, or, at least, one moved by the power of gravity, acting obliquely over the centre or axis of its motion, and having now the most sanguine hopes of success, but not the pecuniary means of carrying on his experiments, which he has hitherto done with his own hands to a great extent, on scientific principles, according with original practical ideas (arising from experience) to the best of his knowledge, exclusively his own, begs leave to submit to encouragers of ingenuity the following proposal:—He solicits a subscription of £20, for which he would engage to produce 20 experimental models of machines illustrative of his ideas, differing in form and appearance, but each equally curious. In case of non-success in his attempts, the models to be presented to the London Mechanics' Institution, or disposed of as a majority of the subscribers may direct. In case of success, ample remuneration would be in his power, and the subscription

returned, or a model of the successful machine furnished to each subscriber of £1.

P.S.—The proposer has several ingenious ideas of inventions of a highly useful nature, which would, at all events, be greatly promoted by the experimental trials for which this subscription is solicited; and for a claim to a talent for ingenious speculation, he begs leave to refer to the Editor of the "Mechanics' Magazine," by whom, and by the publisher of the magazine, subscriptions will be received.

SUBSCRIPTIONS RECEIVED.

The Editor of the "Mechanics' Magazine"	£1	1	0
A few friends of the Editor	1	1	0
T. B.	0	5	0
One of like faith	0	2	6

London, July 9, 1830.

ARGUMENTS FOR AND AGAINST THE POSSIBILITY OF PERPETUAL MOTION; including an Apology for a certain Perpetual Motion Seeker (vol. 14, 1831):—

"Yes; we shall conquer! All those dangers past
Will serve to enrich the future story."

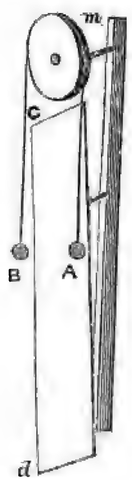
A correspondent says:—

The application to the subject, on my part, has been accompanied by continual experimental elucidations of the subjects considered, and comparisons of these with the axioms, theorems, and demonstrations of one of the best authorities, if I may be allowed so to call my favourite author, Emerson, whose *I says* are generally correct.

I disagree with Mr. B., and do trust that even a perpetual motion seeker might deserve encouragement, if it be found that such a character may exist in a person who is not so ignorant of first principles as Mr. B. supposes *all* are who have this bias; especially if it be found that the person's researches have been connected with subjects of a more tangible nature, relating to the improvement of the useful arts, and particularly to some modern inventions of high importance that are not perfectly correct in their construction.

In this article, Mr. B. advises those who are misspending their time in this pursuit, to consider the question in its most simple form, divested of more complicated operations, which

simple form is that of a pulley accurately constructed so as to reduce the resistance to motion as much as possible. He says, "it will be found, as long as the weights are equal," there will be no motion produced, but wherever the weights are placed they will remain; and to produce vertical motion in the smallest degree, it will be necessary to add a weight to one of the former to create a preponderancy. This weight he calls the mechanical loss, and an insurmountable bar to perpetual motion, &c. We need not follow Mr. B. to his conclusion, as I think this insurmountable bar can be easily removed; and I shall be able to show that this equilibrium, for such it merely is, can be destroyed without adding to one of the weights, or absolutely taking from the other; though this may virtually be considered to be the case, inasmuch as we can at least produce an effect on the system as if the weight were reduced. Mr. B. says, under this arrangement, "wherever the weights are placed they will remain, unless an addition is made to one of them." We will therefore suppose the following diagram to represent the arrangement on a small scale, delicately constructed.



A B are the two weights connected to each other by the string passing over the pulley, and being nicely equalized in their weight, here would, of course, be an equilibrium on the principle of the lever. But take a flat piece of wood, such as a ruler, and place it obliquely in a way so as not to interfere with the pulley *m* in the direction *d*, and then bring the weight to impinge upon it in a way so as not to move the weight A *m*, C *d*, the least, or alter its position. What will be the consequence? Some would say, why, the weight A would then descend, and cause the weight B to ascend. But I should rather say, the re-action of the plane when acted on by the weight B, having destroyed the equilibrium of the forces, motion takes place. Now, if we attribute this motion to the re-action

of the plane on the weight, though we will not go so far as to say motion is generated, yet if we say, by this simple arrangement the equilibrium is destroyed and motion takes place, the least we can admit is, that motion is communicated to the system, and that by the agency of part of the machine itself, the apparatus employed being considered as such: Then, why so much objection to the term self-moving machine in limited sense? But I will not dispute about words, which are but the images of things, and images may be strangely distorted by the medium through which they are received—of which distorting mediums, there is none equal to that of prejudice in favour of abstract notions—which notions perhaps, if rigidly examined, would be found to have no foundation in facts or in common sense.

Another demonstrator of the impossibility of perpetual motion, is Mr. Mackinnon (see "Mech. Mag.," vol. 1, p. 363). As no doubt the different attempts to produce, or communicate, continued and perpetual motion, at least, such as are often brought forward by persons unacquainted with the science of mechanics, are generally to those who are acquainted with that science, if not absolutely ridiculous, yet of a nature to excite a smile at their futility: still there are a few (perhaps a very few) who entertain an opinion that such a thing is not impracticable, and who have, from practical experience as well as study, acquired a tolerable insight into the laws of nature (so far as relate to this subject); who in their turn cannot help smiling at the weak reasoning of some other would-be philosophers, who gravely give their dictum in the case. In this class I include Mr. Mackinnon, who very gravely goes to work to prove, &c., and flatters himself he shall, if rightly understood, help to prevent much future waste of time on the subject. He then goes on to give us his definition of inertia, by which he informs us that a body in a state of rest will remain so until it is moved (wonderful!)—that it cannot move itself—that it has not that power—and that no mechanical contrivance can give it that power. (How profound!) * *

INQUIRY INTO THE POSSIBILITY OF PERPETUAL MOTION (vol. 14, 1831):—

PROPOSITION.—That a wheel can be made to possess more

force in its first revolution than is in the spring that moved it (provided the moving power is not too much or too little) by only making it heavy enough and regulating its diameter; and that this increase of power goes on *ad infinitum*. To demonstrate this will be to demonstrate the possibility of perpetual motion.

First, then, "The moment of any moving body may be considered as a sum of all the moments of the parts of that body," and the expansion of a substance increases the resistance of the air to its motion by exposing more surface. Now, a wheel of a ton weight possesses as much force, when put in motion, as a thousand small ones made of its contents would possess, while it is less resisted by the air, as it has less surface exposed to it.

Secondly, The impediment of friction to a wheel's motion increases with the circumference of the axis (as proved by balancing a beam, which, if balanced on a sharp edge, the least touch will move it), and *vice versa*. Now, if a wheel of a ton weight be divided into a thousand small ones, the axis sufficient to support that wheel must be divided as well into a thousand small bars. The large wheel, moved with the collected force of the thousand small ones, while it was less resisted by the friction as the circumference of its axis, was less than a sum of the circumferences of the thousand small ones. Besides, one-thousandth part of the large axis is not sufficient to support one-thousandth part of the wheel's weight, as a beam of four equal sides will support a greater weight than if split into boards and laid flat. So a small wheel must have a greater axis in proportion to its weight than a large one; consequently it possesses more friction in proportion to its power. And as the wheel is increased, the power increases, for "the motion of all matter is as its quantity," without a proportional increase of resistance from the air or friction.

Thirdly, It is granted that when a wheel is put in motion, that motion would be perpetual only for the resistance of the air and friction. Well, all the force it possesses is present in the first revolution, and can be used to reproduce the moving cause while the resistance can be almost avoided, for it only is produced as the wheel revolves.

I was led by this course of reasoning to make the following experiments. 1. Three wheels, of various sizes, were put in

motion by a force equal to the one-eighth of their respective weights; the smallest was stopped in its first revolution by the same weight that moved it ; the next in size took once and a half; and the largest wheel took twice the moving power to stop it. 2. A wheel, two feet in diameter, had various weights fixed alternately to its periphery, and the weight let fall from the perpendicular, the greater the weight on the wheel, the nearer was it brought round toward the point from which it fell, until the weight was increased to two pounds; here the principal began to diminish until the diameter of the wheel was increased—when increase of weight increased the moment as before. So, there is a certain diameter as well as weight to be considered.

ROBERT TWISS, Jun.

P.S.—Much depends on the organic structure in lessening the size of the machine. I have three models (one moved by a spring, and the rest by a weight) for the inspection of any person disposed to put this plan into execution. In one the power of the lever is present in two places, and in another a weight acts on the whole during its entire revolution, and is replaced by being lifted only two or three inches.

A POWERFUL PERPETUAL MOTION. By W. Pearson (vol. 20, 1834):—

If I understand perpetual motion aright, it means that a machine, or other moving body, must be so constructed that it shall continually work itself without intermission.

If my ideas of perpetual motion are correct, I am confident I have discovered it; for I know a machine which will not only work itself, without the assistance of any person, but will also have a sufficient power to spare, to work any kind of machinery required.

However, setting the question of perpetual motion entirely aside, here is a machine which can be applied to all the purposes steam is applied to, and free from any danger whatever —which is ready for starting at any moment, and, except the act of setting in motion and stopping, requires no farther attending to.

The contrivance is so simple that I can calculate the gain and loss of every part of it; and am positive that what is

now considered a very small engine, if constructed on my plan, after deducting sufficient power to keep itself in motion, will have to spare, over and above, about 100 stones pressure, which may be applied to any required work; and, by enlarging its dimension, it may be made of any given power.

It will answer admirably for propelling vessels across the seas, as they are now done by steam; and as no fuel is needed, it certainly is a desideratum. The engine is much more compact, and will be free of that uncomfortable heat which is so much felt in steamers.

I do not think it proper, at present, to explain more particularly the nature of this machine, for I believe there are people in the world who would not scruple to take advantage of my labour and study. This being the case, I have not sent a drawing and description, as I first intended; but if any gentleman, merchant, mechanic, &c., of known integrity, who needs such an engine, or wishes to know if it be possible to make one, will secure me, by a patent or any other sufficient means, an adequate return for the invention, I will prove to him by a drawing (if he knows anything about a machine) that it cannot fail to answer the desired end.

It is not in my power to try it; and yet an engine of this description will cost much less than a steam-engine of the same power, without any running expense for fuel, &c., upon it.

Confident I am not mistaken, I will not shrink behind an anonymous signature, but openly, and at once, acknowledge myself as

Yours, &c.,

WILLIAM PEARSON.

Bishop Auckland, Jan. 6, 1834.

P.S.—Many hold that it is impossible for a machine to expend the same power it works with; but let me inform them that I have brought an ally into the field which does the most material part of the work, and yet requires no outlay of power in return.

SELF-ACTING MACHINERY.—W. Pearson (vol. 23, 1835) again writes:—

The possibility of making a perpetual motion, or machinery to generate the power it works with, is affected to be treated

as an "idle chimera," equally vain and opposed to the well-established laws of nature and mechanics; but in spite of this, perpetual motion seekers are more numerous than any superficial observer may imagine. Having already made an avowal of my confidence of the practicability of making self-acting machinery, I have had occasion to hear much said on the subject. Many with whom I have conversed, after quoting what this or that learned gentleman has said on the impossibility of the thing, have taken "heart of grace" from hearing me still profess my confidence in my plans, and at length acknowledge that they themselves turned their attention to it at one time, and believed they could lay down plans by which self-acting machinery could be made to do such and such particular work! One person, after "beating about the bush" as above, alleged that he could "make a wheel which would be able to turn a *grunstane!*" Thus you see, Sir, perpetual motion seekers abound; and though they pretend to laugh at the idea, yet are they secretly labouring to catch—what is it Bishop Wilkins calls it?—the "chaste wanton."

I believe most of the engineers of the present day have been perpetual motion seekers; but, disappointed by repeated failures, have given up the thing as a false, deluding chimera, unworthy of their study: though I have heard it said (whether true or false I know not, neither is there any offence meant) that Mr. Hancock, of steam-carriage celebrity, remarked once, that "if he had an hundred sons, he would like them all to study perpetual motion; for, if it had no other beneficial effect, it would make them familiar with the various modes of connecting the working parts of machinery."

[After a little pleasantry in the way of proposing some incredible machinery, he proceeds:—]

Sir Isaac Newton, it is said, hinted something about a fool when *he* failed of discovering the perpetual motion. How far *I* may tally with the learned astronomer's ideas of one, I know not; but certainly I have no ambition to contend for the title. Though the veteran mathematician did not express himself in the self-sufficient style of some of our *ci-devant* perpetual motion seekers after they had failed,—"Phoo! it's all fudge; there is no such thing: haven't I tried it *all ways?*" —yet I must say it was rather ungenerous of him to place a

disgraceful bar in the way of the successful student. I am not unaware, however, that many people consider me a downright ninny, for coming forward as I have done, in a plain, open, decisive manner; but how far I may really merit the epithet, remains eventually to be proved. If, after setting up my name as a target for the arrows of criticism to be pointed at, it is clearly demonstrated that I am in error, then, indeed, I cannot but acknowledge the term will be very justly applied. However, it may suffice at present when I say, "I do not fear the result!"

Mr. Mackintosh, in a lecture delivered in October, in relation to the laws and sources of motion (vol. 26, 1836), says:—

All mechanical motion resulting from gravity tends from a circumference to a centre, the time which the motion continues being greater or less as the velocity or distance from the centre is greater or less.

If chemical motion continually tends from the centre to the circumference, a perpetual chemical motion is impossible, because, whatever may be the dimensions of the mass, it must have a centre, at which point chemical action would cease.

If mechanical motion continually tends to a centre, a perpetual mechanical motion is impossible, because, whatever may be the dimensions of a circle, it must have a centre, at which point mechanical motion would cease.

But a perpetual motion may and does exist, and is a necessary result of the two forces, viz., of chemical motion tending *from* a centre, and of mechanical motion tending *to* a centre; and these two forces may and will continue to produce motion for ever.

SECTION II.—*Its Possibility Denied.*

A correspondent (vol. 1, 1823), speaking of the London Mechanics' Institute, about to be established, observes:—

Amongst the various other important benefits to be derived from the proposed institution, will be that of demonstrating,

in intelligible terms, the total fallacy and inutility of certain pursuits after the chimera of perpetual motion, in search of which so many have sunk their little capital and many of their best years of existence, which might have been prevented by an acquaintance with the first elements of mechanics.

In some recent cases which have come to my knowledge, the visionary mechanics have been objects of pity, from the encouragement given to them by persons who ought to have been qualified to have given better advice. These dark and golden dreams, the seeds of fruitless patents, will, it is to be hoped, be diminished by a more general diffusion of mechanical knowledge.

[He concludes his letter with:—]

Perhaps some of your correspondents will favour the public, through the medium of your Magazine, with a short history of some of the most specious attempts to produce a generating power, or a machine capable of working from a power raised by itself.

"A Constant Reader" (vol. 1, 1823) states:—

* * * I have witnessed, however, a nearer approach to a method of obtaining perpetual motion than is set forth by your correspondent, which, if I comprehend it rightly, only shows one pump for raising the water over the wheel, but which is not sufficient to carry the wheel round. In the case I witnessed, there were two pumps, which moved successively after each other, by which means the wheel, if it were possible to overcome the friction, would be kept in constant motion; whereas, after the contents of a single pump are discharged on the wheel, it would immediately stop.

But, however an engine of this description may be made, it is utterly impossible to overcome the friction of the bearings, couplings, levers, &c.

NO PERPETUAL MOTION (vol. 1, 1823).—The writer says:—

I would advise those persons who yet may be misspending their valuable time on this vain pursuit, to consider the ques-

tion in its most simple form, divested of the more complex operations of raising water by means of pumps, as these operations always involve questions of difficulty as to the proportion of power expended to the effect produced; taking into account that the real mechanical effect in all hydraulic machines falls much below the power expended. Let the question be, therefore, considered by means of a simple pulley, mounted on friction wheels, so as to reduce the resistance to motion as much as possible: let us also suppose a line passing over this pulley, without weight, and without rigidity or stiffness; at each end of this line let there be attached an equal weight. As the subject is of importance, it will be right to consider well the result of this arrangement. It will be found that so long as the weights are equal there will be no motion produced, but that wherever the weights are placed they will remain; and to produce vertical motion, even in the smallest degree, it will be necessary to add a weight to one of the former, to create a preponderancy: this additional weight is therefore the mechanical loss, and the insurmountable bar to perpetual motion. All attempts to get rid of this difficulty, by the introduction of pumps, whether the common lifting pumps, the spiral cylinder, or any other rotatory machinery, will only serve to increase the loss of power, by the friction inseparable from every part of a machine.

[He says that—]

If one hundred gallons of water be made to operate upon any pump, with a fall of ten feet, it will be found that the quantity raised to the height of ten feet will be several gallons short of one hundred.

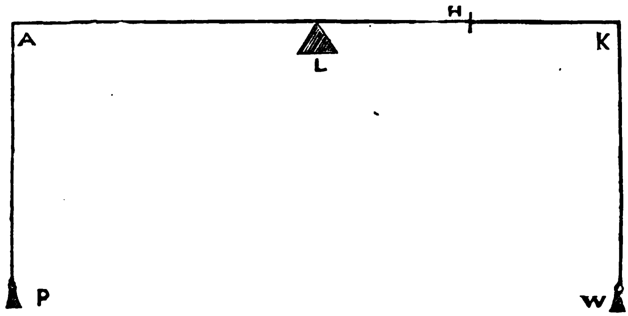
[He adds :—]

A very considerable portion of the fruitless attempts to procure a generating power, that have come to my knowledge in the course of the last twenty-five years, have been founded upon the presumption that a machine could be made to raise more water than was required for its own operation. A due consideration of the less complicated question of a pulley with two equal weights sufficiently proves that the presumption could never be realized.

No Perpetual Motion (vol. 1, 1823):—

Your correspondent has taken up a very wrong position when he insinuates that a perpetual motion cannot be made, because matter is inert. That matter is inert, no one will deny; but motion is as natural to matter as inertness. This was long ago asserted by Des Cartes: impress motion upon any mass, and it will keep that motion for ever, if not affected by any other agent; witness the harmonious motion of the celestial spheres.

The want of a perpetual motion arises from a very different cause than that of the inertia of matter. In the science of statics there are a few things most essentially necessary to be considered, and these are strikingly illustrated by the simple lever.



Let A K be an inflexible bar without weight; place it on the fulcrum L: place equal weights, P and W, at each end; these will evidently balance each other; put them in motion in a vertical plane, and the descent of the one will be equal to the ascent of the other; the times of ascent and descent will be the same; in short, a perfect statical equilibrium obtains—that is, the times, the velocities, the momenta, and the space passed over in each are respectively alike. Now, let the weight W, of six ounces, be placed at H; then, by the properties of the lever, $W \times H\,L = P \times A\,L$; hence $\frac{W \times H\,L}{A\,L} = P$, that is, $6 \times 2{\cdot}5 = 15$, and 15 divided by $4{\cdot}5 = 3{\cdot}3$, the weight P; in this position the balance is still

preserved. The times of ascent and descent are equal; the velocities and spaces described are unequal; being as 4·5 is to 2·5; but this is again compensated by the momenta; for, since that is as the quantity of matter multiplied into its velocity, we shall have for the momentum of P $3 \cdot 3 \times 4 \cdot 5 = 15$, and for W it will be $6 \times 2 \cdot 5 = 15$; here, again, the momenta are brought into an equilibrated state, and of course motion will cease. The same truth will hold good in any other position, and in any other machine, however complicated may be its construction; for it has been asserted by an eminent astronomer and mechanical philosopher, that upon this principle depends the whole of mechanics; and it holds universally true that when the bodies are suspended on any machine, so as to act contrary to each other, if the machine be put into motion, and the perpendicular ascent of one body multiplied into its weight be equal to the perpendicular descent of the other body multiplied into its weight, those bodies, how unequal soever, will balance one another in all situations. In hydraulic machinery the same law holds true, and it is strikingly exemplified in the syphon. Suppose a vessel whose surface contains 16 superficial inches, and a syphon whose bore contains exactly one superficial inch—that is, any transverse section of the tube—it is well known that, if the longer leg of the syphon be on the same level with the surface of the water in the vessel, the water will not run, even though means be used to effect its egress. The reason is obvious: let the pressure of the atmosphere be 15 pounds on the square inch; since fluids press alike in all directions, the 15 pounds of upward pressure will exactly balance the pressure of 240 on the vessel; for, if 16 inches of water were to be forced through the syphon, the water in the vessel would only fall one inch, and this velocity 1×240 (the pressure on the vessel) $= 240$, and the velocity of the syphon 16×15 (its atmospheric pressure) $= 240$. Let the end of the longer leg be brought below the level of the surface of the water in the vessel, so as between that level and the point of discharge may contain one pound of water; and since this one pound of water acts against the 15 pounds of atmospheric pressure, hence 14 pounds only remain, which do not balance the pressure upon the vessel; in this case the water will flow; but no mechanical advantage can possibly be derived from this circumstance; for although the velo-

cities are as 16 to 1, yet the quantities are equal, the times are equal, and the momenta are equal; for the momentum or force thus generated by the affluent water can never raise a quantity in the slightest degree greater than itself to the point where it fell from; and, so long as nature acts in this form, in vain shall we look for a perpetual motion.

[He then quotes from Dr. Gregory, where he illustrates the impossibility of perpetual motion by the balance invented by Dr. Desaguliers.]

Invariable rather than Perpetual Motion to be Sought after (vol. 2, 1824):—

Notwithstanding the many ingenious papers which have appeared in your Magazine, tending to elucidate the subject of perpetual motion, with the laudable view of restraining deluded genius from the pursuit of an object which can never be attained, it seems pretty clear (from the observations of F. J.) that they have all proved insufficient to effect this purpose. It is not enough for one enamoured with his imagined discoveries, and more or less hallucinated by a long and almost incessant contemplation of them, to be shown the unsuccessful attempts of others; nor is it sufficient that a skilful mathematician can comprehend the demonstration of its impossibility; but I hope many may be restrained, by convincing them that it would be utterly useless if discovered, and that the pursuit of it is disreputable in the eyes of scientific men.

When, however, I assert that perpetual motion can never be obtained, I wish to be understood, that it cannot be produced by any means strictly mechanical, or hydrostatical: that it may be practicable by other means, must be sufficiently obvious to every theorist. For example: let a tube be made in the form of those used in common wheel barometers, sufficiently capacious to contain several hundred pounds of mercury; then suspend a weight on the surface of the mercury, with a proportional counterpoise, so placed, that every ascent, as well as descent, shall renovate the maintaining power of a train of wheels, terminated by a delicately small balance. By this means a very small alteration in the pres-

sure of the atmosphere will wind up the weight or spring sufficiently to maintain the vibrations of a balance for a period of two, or three, or more weeks, according to the weight of the column of mercury suspended in the tube. If it be objected, that there is a possibility of the atmosphere preserving an uniform pressure for so long a period, a thermometer constructed pyrometrically (*i.e.*, with bars of metal possessing an equal expansibility) may be substituted;* and as the power of this may, like the last, be accumulated to any given extent, it may be made to require only the constant changes of season to impart to the machine sufficient power to render it totally independent of the minor and inconstant variations of temperature, from which it would nevertheless frequently derive a renewal of power.

But to produce perpetual motion by mechanical means, is a proposition which in itself implies a contradiction: mechanical motion consists in an approximation to mechanical equilibrium, and it is therefore a contradiction to say that a body, or system of bodies, can constantly approach without ultimately arriving at that point of equilibrium where motion ceases.† If, again, it be said that motion may be produced without approaching the point of equilibrium, an equally obvious contradiction is involved; for the proposition comes to this, that we may produce, by the expenditure of a given quantity of power, a renovating power greater than that expended, which is impossible. It may not, perhaps, be so distinctly evident; but it is no less capable of demonstration, that projected bodies of any description, deriving their force from their momentum, are subject to the same or (in their result) similar laws, and equally inadequate to produce perpetual motion.

Let me exhort those of your readers, who will not be convinced of the impracticability of their schemes, and who, after all that has been said, still imagine that they can accomplish that which has baffled the learned of all ages; who esteem those facts which science has established, and which have been demonstrated to our understanding, and proved to our

* See Nicholson on the Solid Thermometer, p. 127.

† Mathematically, perpetual approximation may easily be conceived. Not so here, because the motion of a specific body requires a specific power to maintain it; and when the power becomes less than that quantity, the motion ceases.

senses, to be merely as "customs," or fashions, which they can lay aside when they impede their operations: these I would advise to relinquish a pursuit which is profitable neither to society nor to themselves, and direct their exertions to the investigation of subjects in which their success would entitle them to remuneration for the trouble and anxiety inseparable from speculative experiments. Instead of studying perpetual motion, which has hitherto produced nothing but perpetual nonsense, let their object be an invariable motion. The necessity of winding up such machines at certain periods, is a circumstance altogether unimportant and frivolous, while it remains to obviate the evils arising from external motion; to neutralize the effects of heat and cold, without the introduction of other evils; to prevent the variable and injurious influence of oil, &c., &c.

In vol. 3, 1824, a correspondent, who signs "Esperance," gives the following as a memorandum made by him "while perusing some works relating to the controversy of finite particles:"—

Dec., 1813.—The theory of a finite quantity of matter being composed of an infinite number of particles, as to the truth of which mathematicians are divided in opinion, may perhaps be compared to that of perpetual motion. For mathematicians, on the other side, say, it is a contradiction to suppose anything of finite dimensions can be composed of infinities, which certainly appears correct in principle; yet, on the other hand, it is argued that no certain number of parts of which any matter consists can be supposed, without having an idea of a greater number, even *ad infinitum*. On the same ground, although no certain time can be pointed out which forms the maximum of the movements of machinery, nor can any length of time be conceived without an idea of greater extent, to which, by increasing either the moving power or the complication of the inferior parts, the motion may be carried: yet perpetual motion, as a mechanic principle, is visionary. *Query.*—Will this at all explain the subject which has been so long controverted, as it proves the maintainers of both sides of the question to be to a certain degree right?

This argument, of course, alludes to engines where a mechanical power is the moving force, and not a chemical power, as the electrical pendulum.

A correspondent (vol. 5, 1825) directs his remarks chiefly against the singular opinions of Mr. Pasley, who believes "that a perpetual-motion-making cause may yet be discovered, and that following such an *ignis fatuus* may lead to the path of wisdom," and observes:—

On the contrary, this vain pursuit has been known, even in the present age, to lead to poverty and ruin; and, indeed, what else can be expected, when speculators construct machines without understanding the first principles of mechanics? Such was the case with myself (perhaps thirty-five years since), when, believing that nature abhorred a vacuum, I constructed a syphon with a small bore as far as the water was to ascend, and a large bore in the shorter descending leg; fully expecting that the weight of the larger column of water would draw up the smaller column out of a basin, and permit the liquid to fall into the vessel from whence it came, and turn a wheel in its descent.* Another of my raw youthful speculations consisted in a water-wheel, contrived so as to pump up water near the centre of it, a part only of which I supposed would be amply sufficient to keep the wheel in motion, by the great power it would possess if conveyed into buckets at the wheel's circumference. I did not then know the universal law of mechanics, which must inevitably demolish all similar projects in machinery, viz., that whatever is gained in power is lost in time.

I believe the idea, that a perpetual-motion-making cause may yet be discovered, arises principally from ignorance of the laws of nature which relate to machinery, but partly from a notion which has been broached by certain pantheistical philosophers, that a propensity to motion is an innate and essential property of the particles of matter. Yet, in opposition to this doctrine, the natural immobility and inertness of matter are obvious wherever we turn our eyes; and the pro-

* For this favourite idea, see Appendix B; and Zonca's work on Machines, 1607, folio.

jectile motion in the planets, &c., can no more be an innate quality than it is in a cannon-ball. The whole universe is, indeed, an example of perpetual motion, as respects the larger masses of matter, yet the motion in all cases seems to proceed from an external or mental cause.

The circulation of the blood in animals seems to be caused by a series of galvanic shocks; but a constant external supply of food, air, and heat is indispensable, and shows that the motion of the heart, &c., is not an innate propensity. A watermill in a large river may be deemed a real perpetual motion; but the weight or gravity of the water, which constantly carries it towards the ocean, proves that some other agent must convey it up again towards its source.

[On Mr. Pasley's version of the projectile force, he remarks:—]

What! is the projectile force (as exemplified on the largest scale in the planetary system) a nullity? On the contrary, that is precisely the kind of force which all perpetual motion seekers should cherish above all others; for it is acknowledged that bodies projected into space move on *ad infinitum* with their original velocity, unless obstructed by the air or some other agent.

Without wishing any one to place a blind reliance on great authorities, I think no person ought to presume to promulgate any anti-Newtonian doctrines, till they have given sound reasons for rejecting the established system.

[This he says in allusion to such common-sense philosophers as Sir R. Phillips and others.]

* * * * * * *

I fear the delusive projects for perpetual motion have been encouraged in no small degree by the disingenuousness of the Marquis of Worcester, who, like some of your correspondents, scruples not to insinuate that he has actually succeeded in this hopeful attempt.

The wheel that he speaks of in No. 56 of his "Century of" ingenious speculations, rather than "inventions," certainly would not move of itself, though it is possible to make the weights descend at a greater distance from the centre than their ascending distance.

[He complains of Nos. 78 and 98 as fallacious; and—]

Nos. 99 and 100 are complete castles in the air, or else

they are worth a thousand of perpetual motions. The descent of 1 lb. is to raise 100 lbs. as high as the 1 lb. falls, in defiance of the mechanical principle—that what we gain in power we lose in time, &c.

The Editor (vol. 10, 1828) says:—

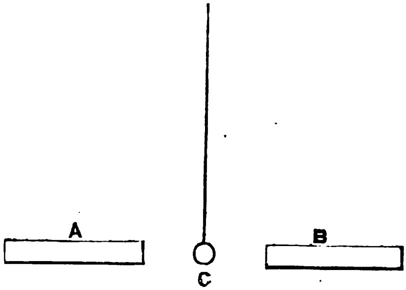
Philobrune, who expresses his determination never to believe in the impossibility of perpetual motion, until he has "spent twenty or thirty pounds in the trial," and who wishes for a candid examination of the arguments for and against it, will be pleased to learn that we propose inserting, shortly, a series of clever papers, which profess to have that object in view, by a correspondent nearly as incredulous as himself. We, however, recommend him to keep his money in his pocket till he has read these papers, and what may possibly be offered in reply to them. Strange to stay, notwithstanding all that has been experimented and written on the subject, the "Philobrunes" are still a very numerous class; and while they are so, no apology can be necessary for appropriating a portion of our pages to their conversion.

A lecturer (vol. 10, 1828) writes:—

Perpetual motion is, and ever must be, an impossibility. For, consider motion abstractedly from matter—a certain quantity of motion is communicated to a given body, and the seeker after perpetual motion endeavours, by the agency of machinery, to make it return to the same place again, and so continue for ever. Now, were there no such things as friction and resistance, all would be well; but as long as bodies continue to part with their motion to surrounding bodies, so long will perpetual motion be unattainable. It is of no use to invent machinery to economize the motion: at the return of each circulation, the motion must and will be less than it was at the end of the preceding one, and so it will continue till the machine stops.

Neither is it reasonable to suppose that, by the agency of any uniform moving power (if I may be allowed the expression), such as the magnet, the earth's attraction, the atmospheric pressure, &c., we can attain perpetual motion. For

instance, in the magnet, all cases may be reduced to the following:—There are two magnets, A and B, and another body, as C, to be attracted, first by one and then by the other, as in the figure.



First, then, A is to have sufficient power to attract C away from B; and then B is to have a greater power, to draw C away from A. Now, if the power of B be greater than the power of A, it could never have attracted C away from B in the first instance; and if B be less than A, B can never draw it back in the second. To suppose, then, that in any arrangements of magnets, first one should have the greater power and then the other, is absurd; and the same holds good of any uniform source of motion whatever.

In writing the above, I have gone at once to first principles, considering that I wrote for persons who understood the subject; for in investigating questions of this nature, we must not stop to consider the best passage for fluids, the superiority of a friction roller, or the advantages of a lever, but go at once to the first principles; the same as in algebra we clear an equation of all unnecessary quantities. * * If I have made the case clear, it may preserve talents from being wasted upon that which is not attainable.

Scripture Texts (vol. 11, 1829).—What the following has to do with the subject, it is difficult to surmise: but its author seems in good earnest:—

"Notice to Perpetual Motion Seekers."—The following is a literal copy of a communication which we have re-

ceived under this head. We publish it for the benefit of all concerned:—"Perpetual Motion Seekers! see Coloss., ch. ii., v. 8—'Beware lest any man spoil you, through philosophy and vain deceit, after the tradition of men, after the rudiments of the world.' Ye are making the words of God of none effect by your traditions, in publishing these things to the world. How can such toys and baubles as these be perpetual? See Malachi, ch. iv., v. 1—'For behold the day cometh that shall burn as an oven; and all the proud, yea, all that do wickedly, shall be as stubble.' Here is the end of them. I the undersigned have to inform the public, the model for making perpetual motion is to be found in that too much neglected book of models, the Bible. I called upon the Lord, and he showed it to me. I said, 'Lord, shall I show this unto them?' This was the answer to me:—See Isaiah, ch. xli., v. 29—'Behold, they are all vanity; their works are nothing.' I said, 'Lord, be pleased to show me some more about it.' 'Bring forth your strong reasons, saith the King of Jacob.'—Isaiah, ch. xli., v. 21. This was the answer:—See Isaiah, ch. xli., v. 14—'Fear not, thou worm Jacob. * * Behold, I will make thee a new sharp threshing instrument having teeth; thou shalt thresh the mountains, and beat them small, and shall make the hills as chaff.' See also Jeremiah, ch. viii., v. 9—'The wise men are ashamed; they are dismayed and taken,' &c. See also Jeremiah, ch. ix., v. 12—'Who is the wise man that may understand this?' If there is not a wise and learned man who can show this, there is a deaf and unlearned man that will, by the blessing of God, set it forth to you. I am that deaf and unlearned man, GEORGE LOVATT, Stafford.

"P.S.—Mr. Editor: I have told you what I was commanded to do. See Ezekiel, ch. iii., v. 4 to the end. Now, see thou forget it not; let those models which come from the Word of God have the first place.—Joshua, ch. xxiv., v. 15."

A correspondent, and the Editor's note (vol. 13, 1830), appear as follows:—

"I believe there are principles, could they be brought into action, which would effect the desired purpose, and the difficulty is mostly in the practical application."

Sir,—The above is the conclusion of "Hezron's" letter

in your 366th number, who, "at some sacrifice of valuable space," has described a perpetual motion, the most unlikely to keep moving that ever was thought of.

Now, Sir, if "Hezron" will point out the "principles" he speaks of, I will engage to remove every "difficulty" that stands in the way of their "practical application."

The pursuit of the perpetual motion has been supposed by some to render the same service to mechanics which the efforts to discover the philosopher's stone are said to have rendered to chemistry. Whether or not the latter science has been improved by the dreams of the alchymists, I am not prepared to say; but I think I may assert, without fear of contradiction, that the science of mechanics neither has been, nor ever will be, benefited by the attempts to discover a perpetual motion. What probability is there of persons improving a science, who are completely ignorant of it? And this is almost universally the case with perpetual motion seekers. What benefit has science ever derived from their exertions? I believe none at all.

To believe in the possibility of the perpetual motion involves the absurdity of believing that the same thing may be greater or less than itself. I cannot help lamenting that ingenuity should be thrown away in endeavouring to discover what, from the nature of things, never can exist in this world; when, at the same time, that ingenuity might be productive of public good and the private advantage of its possessor, if properly directed.

[We do not think that a belief in the possibility of perpetual motion argues such complete ignorance as "S. Y." supposes: of this, at least, we are well satisfied, that "Hezron" possesses both information and ingenuity enough to prove himself a troublesome antagonist to any one, be his scientific attainments what they may. "S. Y." should in candour have noticed that the scheme given in No. 366 was not one of "Hezron's" own, but an attempt to exemplify one of the Marquis of Worcester's Century of Inventions. Neither do we agree with "S. Y." that the subject is one from the prosecution of which nothing is to be gained to the science of mechanics. We conceive that were the result of the experiments for which "Hezron" solicits subscriptions to do even no more than this—convince the many hundreds (thousands, we may say) who still cherish the notion that a

perpetual motion is possible, of the fallacy of the thing, it would do a great deal of good, inasmuch as it would direct into channels of practical utility, all that labour and ingenuity which are now fruitlessly spent in pursuit of the (alleged) chimera.—ED. M. M.]

DISCOVERING IMPOSSIBILITIES (vol. 17, 1832):—

M. Mathulon, a manufacturer of stuffs at Lyons, once announced that he had discovered the quadrature of the circle and the perpetual motion, and he deposited 1000 crowns, to be awarded to any person who should prove that he was in error. M. Nicole effectually did this, and the thousand crowns were awarded to him, and were presented by him to the General Hospital at Lyons.

A FEW WORDS TO THE PERPETUAL MOTIONISTS (vol. 17, 1832):—

Gentlemen,—

"When leave you off your vagaries?"

Five-and-twenty years ago, I entertained the notion of making a machine, not only to work itself, but to put in motion as many traps as Bishop Blaize in the miniature wool machinery of a show, that used to go about the fairs in the north of England, when I was a lad. As soon as I had got the necessary tools, I made a wheel of brass, with weights, friction-wheels, &c., to be thrown out from the centre on the one side, and brought near to the centre on the opposite side, by means of guide-rings. The whole was made of well-lackered brass, and contained in a frame-work of the best mahogany. So confident was I of its working, that I hardly thought it possible my hobby could fail, and actually prepared myself with a table-cloth to stop it in case it should go so fast as to break in pieces! I thus gained some experience, and beginning to inquire of men, books, and machines, I soon found that the great enemy to all perpetual or self-acting machines is friction and gravity.

Emerson says, prop. 116, cor. 1, "Hence it follows, that if any weight is moved by help of a machine, what is gained in

power is lost in time." Again, cor. 2, "Hence the motion of the weight is not at all increased by any engine or mechanical instrument (think of that, gentlemen), only the velocity of the weight is so much diminished thereby, that the quantity of motion of the weight may not exceed the quantity of motion of the power; and, therefore, it is a vain fancy of any one to think that he can move a great weight with a little power, and with the same velocity as with a greater power!" So that, gentlemen, if your machines or wheels were to run in diamonds, your pumps to be of glass, still you would find a few drops of water necessary to overcome friction; which drops must, of course, be lost, for they cannot be got up to the overshot wheel again without some extra power. It is reported in America that a clock has been invented, going without help! I have heard of clocks going seven years in England; but, as Peter Keir said of Wolf and Edward's new steam-engine in Lambeth (about, I think, 1810) which ground 19 bushels of corn with one bushel of coals, "that's a thing only to be believed on seeing it." But even suppose you could make a machine to go or work of itself, it could have no overplus power to spare for any other purpose, and would therefore be of no practical utility whatever.

I will allow that perpetual motion-hunting is a very pleasant and exciting pursuit. It may be compared to being in a sort of waking dream, and in the one case so in the other it is very vexatious to be jilted.—I am, gentlemen, your well-wisher,

WILLIAM REED.

Peterhoff Paper-mill, near St. Petersburgh,
January 19, 1832.

Editorial Notice (vol. 19, 1833):—

[A correspondent, writing November, 1832, having spoken against the publication of fallacious schemes, the Editor gives as a reason for admitting all into his journal, a hope to do good to the "seekers" themselves.]

They are still, notwithstanding the wide diffusion of scientific knowledge in modern times, a very numerous race: almost every village can boast of some lone enthusiast of this de-

scription. Now, as there is a common fallacy which pervades all schemes for effecting a perpetual motion, the chances are, that by subjecting any one of the number to the test of a public examination, and thereby ensuring its refutation, you will demolish hundreds of others, and, while thus exposing the folly of one visionary, may be the means of curing many. We know, indeed, that, in point of fact, our journal has in this way done much good.

The following article is quoted in vol. 27, 1837:—

Two classes of persons are inveigled into this hopeless quest: the first is the projector,—generally a man who can handle tools, and who is gifted with some small power of invention—a faculty, as Mr. Babbage justly observes, by no means rare, and of little use unless coupled with some knowledge of what others have done before him. Of the inventions already made—of the experiments which have been tried and have failed—our projector is usually profoundly ignorant. What are called the laws of mechanics—namely, general truths which were established by the observations of scientific men in times past, and which are now admitted by all who take the trouble to investigate them—he has either never heard of, or chooses to set at nought without inquiry. The other class is that which finds capital. The projector, having perhaps exhausted his own funds, takes his scheme to some person who has a little money to spare, and dazzles him with the prospects of sudden and splendid wealth; little by little, he is drawn into expenses which neither of them, perhaps, had anticipated. Failure after failure ensues, but still all is to be right at last. The fear of ridicule—the necessity for retrieving, the one his capital, the other his credit,—these motives carry them on till the ruin of both puts a termination to their folly.

Unhappily, however, the stage is quickly occupied by other adventurers, profiting nothing by the fate of their precursors; and yet one would think that a very slight consideration of the subject would be sufficient to shew the absurdity of the undertaking. What is the object aimed at? Is it to make a machine which, being once set in motion, shall go on without stopping until it is worn out? Every person en-

gaged in the pursuit of the perpetual motion would perhaps accept this as a true statement of the object in view. Yet nothing is more easy than to make such a machine. There are from ten to twenty of them at work at this moment on the Rhine, opposite Mayence. These are water-mills in boats, which are moored in a certain part of the river; and, as the Rhine is never dry, these mills, which are simple in their construction, would go on for years—go on, indeed, until they were worn out. But if this instance were mentioned, the projector would perceive that the statement of his object was imperfect. It must run thus:—a machine which, being set in motion, shall go on till worn out, without any power being employed to keep it in motion.

Probably few persons who embark in such a project sit down beforehand to consider thoroughly what it is they are about to undertake, otherwise it could hardly require much knowledge of mechanics to see the impossibility of constructing such a machine. Take as many shafts, wheels, pulleys, and springs as you please; if you throw them in a heap in the corner of your room, you do not expect them to move; it is only when put together that the wildest enthusiast expects them to be endowed with the power of self-movement; nor then, unless the machine is set going. I never heard of a projector who expected his engine to set off the moment the last nail was driven, or instantly on the last stroke of the file. And why not? A machine that would continue to go of itself would begin of itself. No machine can be made which has not some friction, which, however slight, would in a short time exhaust any power that could have been employed merely for the purpose of setting it in motion. But a machine must not only keep moving itself, but furnish power; or, in other words, it must not only keep in motion, but it must have power to expend in some labour, as grinding corn, rolling metals, urging forward a vessel or a carriage; so that by an arrangement of parts which of themselves have no moving power, the projector expects to make a machine, self-moving, and with the power of performing some useful task!

"Father, I have invented a perpetual motion!" said a little fellow of eight years old. "It is thus: I would make a great wheel, and fix it up like a water-wheel; at the top I would hang a great weight, and at the bottom I would hang

a number of little weights: then the great weight would turn the wheel half round and sink to the bottom, because it is so heavy; and when the little weights reached the top they would sink down, because they are so many; and thus the wheel would turn round for ever." The child's fallacy is a type of all the blunders which are made on this subject. Follow a projector in his description, and if it be not perfectly unintelligible, which it often is, it always proves that he expects to find certain of his movements alternately strong and weak—not according to the laws of nature, but according to the wants of his mechanism.

If man could produce a machine which would generate the power by which it is worked, he would become a creator. All he has hitherto done—all, I may safely predict, he ever will do—is to mould existing power so as to make it perform his bidding. He can make the waterfall in the brook spin his cotton, or print his book by means of machinery; but a mill to pump water enough to keep itself at work he cannot make. Absurd as it may seem, the experiment has been tried; but, in truth, no scheme is too absurd for adoption by the seekers after perpetual motion. A machine, then, is a mere conductor of power into a useful channel. The wind grinds the corn—the sails, the shafts, and the stones are only the means by which the power of the wind can be turned to that particular purpose; so it is the heat thrown out by the burning coal which performs all the multifarious operations of the steam-engine, the machinery being only the connecting links between the cause and the effect.—"Penny Magazine."

DISCOURAGEMENTS FOR PERPETUAL MOTIONISTS (vol. 41, 1844).—A correspondent gives the following extracts from Mudie's "Popular Mathematics:"—

"Of the vast number of inventions and projects which are every day brought before the public—not as mere bubbles or impostures, but with perfect honesty and zeal on the part of the projectors—we speak with most charitable liberality when we say that not one in the hundred proves to be of any use, and nine out of every ten are altogether impracticable. The reason clearly is, that neither the projectors nor those b

whom they are encouraged are able to see the impossible elements which their schemes involve; that they look at the possible and promising ones only: and thus a large quantity of well-meant labour and ingenuity is constantly wasted."

In reference to this "lurking impossible quantity," Mr. Mudie says:—"Perhaps we cannot select a better one than that of the 'perpetual motion'—that is, a self-moving machine, which shall not involve any stoppage, save the wearing out of the materials of which it is composed. We believe that the fonder votaries of this visionary project do not take even the wearing out of the materials into the account; but it is necessary to do this: and even this necessity, when analysed, involves the necessity of the machine stopping before the parts are worn out."

"The power which tends to stop the motion of all machines upon the earth's surface is a power which acts constantly and uniformly, never pausing an instant, nor abating a jot; and therefore, in order to get the better of this gravitation, we must have a counteracting power as continually new as itself; and we are not acquainted with any such power, or kind of matter in which such a power could reside. It is not difficult to calculate (upon mathematical principles) that if we could give any piece of matter a motion round the earth at the rate of about 5 miles in a second, or 1,800 miles in an hour, and keep up the motion at this rate, we should overcome the gravitation of that piece of matter. This is what may be regarded as the possible case of perpetual motion.

"In the case of a fixed machine—and the more complicated the machine is, it is the less likely to succeed—the impossible element, in the most simple view we can take of it, is this: to find a piece of matter which, of itself, shall be alternately greater and less than itself, and which shall also remain equal to itself all the time; and if this is not an impossibility, it is not easy to see where impossibility is to be found.

"The knowledge of impossible or absurd quantities, and the method of readily discovering them, are often of great use to us—not only in preventing us from wasting our time in attempting to do that which cannot in the nature of things be done, but in enabling us to prove or demonstrate truth in cases where that cannot be done directly." [Edition 1836, pages 23 to 27.]

PERPETUAL MOTION (vol. 64, 1856) :—

A paper containing certain important inferences from the negation of perpetual motion was recently read at the Royal Institution, by W. R. Grove, Esq., Q.C., F.R.S., &c. In the following remarks we give an abstract of the author's communication :—

Scattered among the writings of philosophers will be found allusions to the subject of perpetual motion, and here and there are arguments like the following :—Such a phenomenon cannot take place, or such a theory must be fallacious, because it involves the idea of perpetual motion. Thus Dr. Roget advanced as an argument against the contact theory of electricity, as originally propounded, that if mere contact of dissimilar metals, without any chemical or molecular change, could produce electricity, then as electricity could, in its turn, be made to produce motion, we should thus get perpetual motion.

It may be well to define, as far as such a definition is possible, what is commonly meant by the term perpetual motion. In one sense, all motion, or rather all force, is perpetual. For example, if a clock weight be wound up, it represents the force derived from the muscles of the arm which turns the key; the muscles again derive force indirectly from the chemical action of the food, and so on. As the weight descends, it conveys motion to the wheels and pendulum; the former giving force off in the form of heat from friction, the latter communicating motion to the air in contact with it, thence to the air of the room—proved in a very simple manner by the ticking heard, which is, in fact, a blow to the organ of hearing. Although ultimately lost to our senses, there is no reason to suppose that the force is ever in fact lost. The weight thus acting reaches the ground quietly, and produces no effect at the termination of its course.

If, instead of being allowed to communicate its force to the works of the clock, the weight be allowed to descend suddenly, as by cutting the string by which it is suspended, it strikes the floor with a force which shakes the house; and thus conveys, almost instantaneously, the amount of force which would be gradually dissipated, though not ultimately consumed, by the clock in a week or nine days.

This idea, however, of the perpetuity of force, is not what

is commonly understood by the term perpetual motion: that expression is used to convey the notion of a motive machine, the initial force of which is restored by the motion produced by itself—a clock, so to speak, which winds itself up by its own wheels and pendulum, a pump which keeps itself going by the weight of the water which it has raised. Another notion, arising from a confusion between static and dynamic forces, was, that motion might be obtained without transferring force, as by a permanent magnet. All sound philosophers are of opinion that such effects are impossible; the work done by a given force, even assuming there were no such thing as friction, aërial resistance, &c., could never be more than equal to the initial force; the theoretical limit is equilibrium. The weight raised at one end of a lever can never, without the fresh application of extraneous force, raise the opposite weight which has produced its own elevation. A force can only produce motion when the resistance to it is less powerful than itself; if equal, it is equilibrium: thus, if motion be produced, resistance, being less than the initial or producing force, cannot reproduce this; for then the weaker would conquer the stronger force.

The object of this evening's communication was not, however, to adduce proofs that perpetual motion, in the sense above defined, is impossible; but assuming that as a recognised truth, to show certain consequences which had resulted, and others which were likely to result, from the negation of perpetual motion; and how this negation may be made a substantive and valuable aid to scientific investigation.

After Oersted made his discovery of electro-magnetism, philosophers of the highest attainments argued that, as a current of electricity, circulating in a wire round a bar of iron, produced magnetism, and as action and re-action are equal, and in contrary directions, a magnet placed within a spiral of wire should produce in the wire an electrical current. Had it occurred to their minds that if a permanent magnet could so produce electricity, and thence necessarily motion, they would thus get, in effect, perpetual motion, they would probably have anticipated the discovery of Faraday, and found that all that was required was to move the magnet with reference to the wire, and thus electricity might have been expected to be produced by a magnet without involving the supposed absurdity.

[The remainder of the paper relates to results arising from heat and freezing.]

On Perpetual Motion (vol. 68, 1858). By General T. Perronet Thompson, M.P. :—

Searches after what is known by the name of a perpetual motion have been at all times so common that it cannot be without use to endeavour to ascertain and set down the circumstances under which such a phenomenon is possible, or the contrary, with the reasons why.

The innumerable attempts at perpetual motion from time to time made known, fail generally by running against two canons which nature has set up, and which it is not in man to bear down: that action and re-action are equal, and that the velocities of the power and weight are inversely as those forces. And it is not unamusing to see how curiously these truths may be disguised, and yet with what certainty they will spring out on the hapless projector, at the moment he thinks, good easy man, his success is in the act of ripening.

The old books of "rare inventions" deal in speculations of this disappointing kind. They conceive of balls, rolling down an inclined plane or series of planes, and, by some crafty modification of art, acquiring velocity enough to carry them to the place from which they came. Or, they pour water on an overshot wheel, with intent that this shall turn machinery to pump the water up again. When the great mechanic of antiquity declared he would move the world if anybody would show him where to fix his machine, why should these apparently minor performances be beyond the reach of man? Simply because the one offers no contradiction to the canons above named, and the others do.

To one who has never reflected on such subjects, it would look like a comparatively easy thing to make a watch which should wind itself up.

A friend of early days went to considerable expense with a machine consisting of a cylinder which turned on friction-wheels, and to its circumference were attached certain arcs or arms of brass, with a weight or ball at the end, and these

were expected to turn or fall into a position approaching the horizontal on one side of the cylinder, and lie snug upon the other. But when tried, it moved for a short time when set in motion, and then stopped; the projector expressing his surprise at the very small help required to make it continue in motion. It was suggested to him to put quicksilver into the arcs or arms, which should run outwards in one of their positions and back again in another; with which he was much elated, but nothing came of it. It was evident, in all these cases, that when the machine stopped there was an exact balance in all its parts, and no surplus of force anywhere by which any motion could be continued.

But though there is no making a perpetual motion by the simple application of mechanical force, there is no difficulty in making what may be called so by the help of certain natural powers, if we can get them; and this by the token that nature is full of perpetual motions. And it is not at all unlikely that by some application of these, something very novel and important may be forthcoming. A mill on a perpetual stream is a perpetual motion, because the stream is. And if we ask why the stream is perpetual, it is because the sun to-day, yesterday, and as long as the world shall last, is drawing up water from the sea by evaporation, which in the absence of the sun condenses itself into the shape of rain, some of which falls into the sea again, and what falls on the land forms rivers. So that the result may be traced to two facts—that the sun is perpetual, and that the world turns round without stopping.

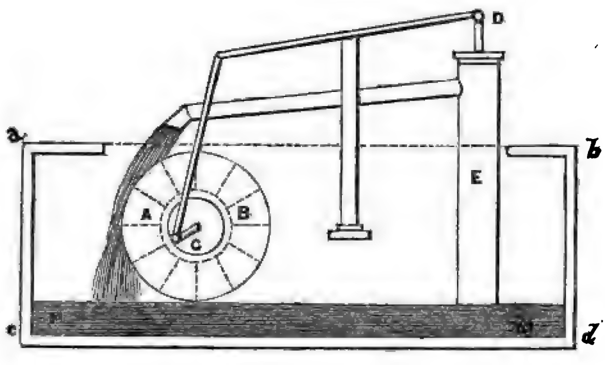
If the force of magnetism had been capable of being intercepted like light, it would have been possible to make a perpetual motion by the attraction of a magnet on steel points in the circumference of a wheel. And here there would have been one of nature's perpetual forces, which man cannot copy. There are ideas abroad that something of this kind is to come of electricity; though how we are to have electricity without working an electrical machine does not appear.

On the whole, however, there is nothing hopeless in the expectation of great results from some of nature's perpetual forces. And one of the first means towards such an end is to cultivate an acquaintance with the impossible which is to be kept clear of.

SECTION III.—*Plans for Effecting Perpetual Motion.*

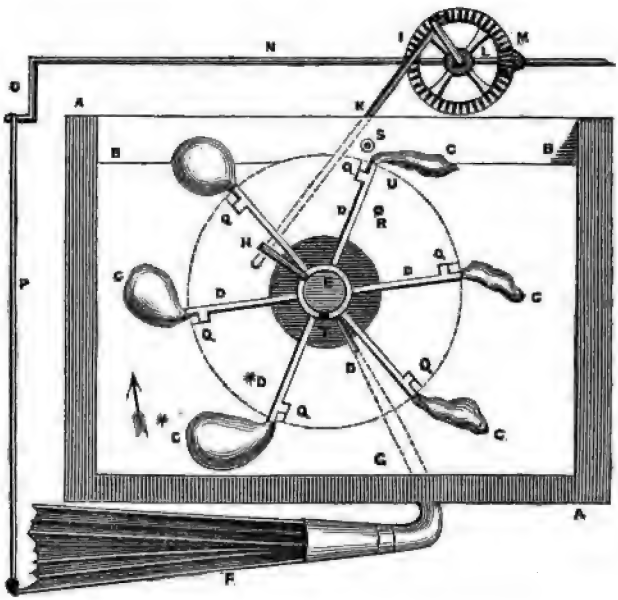
1. A PERPETUAL PUMP.—A correspondent (vol. 1, 1823) sends the following account of the proposed machine :—

I know only of one at present which in theory appeared to the inventor "just the thing;" of course he must have been totally ignorant of the laws of friction.



The above sketch will show his idea. *a b c d* is the section of the reservoir, &c., showing the wheel, the pump, &c. A B is an overshot water-wheel; C D the working beam; E the pump; F a pipe from the top of the pump, through which the water was to fall upon the wheel; C G an arm, communicating, by means of a crank attached to an horizontal shaft through the centre of the wheel, motion to the lever or working beam, and so raising water from the reservoir by means of the pump; H I the water. It was supposed that the water which had fallen upon the wheel into the reservoir would be raised by means of the pump, fall through the horizontal pipe, and so produce a continued rotatory motion.

2. A Hydro-pneumatic Apparatus.—A correspondent (vol. 1, 1823) gives an account of a plan which, though failing from the friction—an insurmountable obstacle—is presumed to have some claim to ingenuity.



A A A A is a cistern of water, filled as high as B B. C C C C C C are six bladders, communicating by the tubes D D D D D D with the hollow axle E, which axle is connected with the bellows F by the pipe G. H is a crank, connected with the crank I by the rod K. L is a saucer-wheel, M a pinion, N its shaft. O is a crank, attached to the bellows F by the rod P. Q Q Q Q Q Q are valves, with a projecting lever. R and S are two projecting knobs. T is a hole in the axle E, forming a communication with it and the lowermost bladder. The axle B being put in motion,

carried round the bladders and tables, and by the cranks H and I, and the connecting-rod K, caused the wheel L to revolve, which, communicating a similar but accelerated motion to the pinion M, shaft N, and crank O, worked or blew the bellows F by the rod P; the air entered the axle E by the tube G, and passing through the hole in it at T, entered the lower bladder C* by the tube D*; this bladder being thus rendered lighter than the space it occupied, ascended, bringing the bladder behind it over the hole in the axle T in like manner, and which thereby gained an ascending power, producing a similar effect on the one behind it. When one of the bladders arrived at the knob S, the lever of the valve Q struck against it, and opened the valve; when the bladder arrived at U and began to descend, its pressure on the water drove out the air, and gave it a descending power; the knob R then closed the valve Q, and prevented the entrance of any water into the bladder; by this contrivance, three of the bladders were full and empty, according as they passed over the hole T or the knob S.

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3. De Luc's Column.—A correspondent (vol. 1, 1823) says:—

Some of your correspondents treat that redoubtable subject, perpetual motion, as a chimera; and others, on the contrary, say that they have discovered the long-sought object, and prove thereby that it is no chimera. A correspondent (F. J.) in No. 11* is one of the latter, but his scheme is only in perspective.

[After a few observations on other communications in the Magazine, he proceeds:—]

There is now existing a perpetual motion, made by Mr.

* Among the Notes to Correspondents, p. 176, the Editor says:—"F. J. asserts that, so far from 'the idea of a self-moving machine' being a mere chimera (as our correspondent Mr. Bevan seems to think), 'had he capital sufficient, he could erect a machine that would do the work of ten thousand horses without any expense but the wear of the machinery.'"

Wansborough, of Fulham, in June, 1818. It was the invention of Professor De Luc, and the mobile is electricity. A gold ball, suspended by a silken thread, vibrates against two gold pillars, and vibrates perpetually. Its principle I do not know, but the Professor explained it satisfactorily to his brethren in science. This is but a pretty plaything, and does not come within the laws of the desired problem, but it still is sufficient to overturn the foundation of Mr. Mactaggart's sermon.*

* * When young, I devoted much of my time to this subject, and devised at least a dozen schemes, rotatory, pendulous, &c., and actually constructed several models; but far from being shaken by such repeated failures, though I have attained a tolerably sober age, my faith is still firm, and so will remain until I have proof of my tenets being wrong. I shall esteem it a great favour if any one would oblige me with this proof, as it might serve to divert my thoughts from a future attempt, which I contemplate.

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4. Another Perpetual Pump.—A correspondent (vol. 1, 1823) observes :—

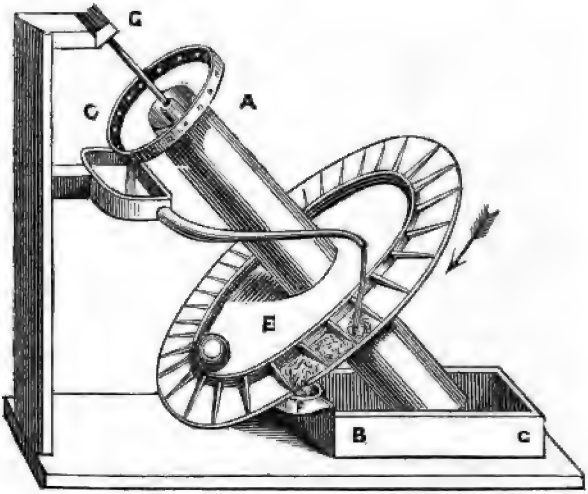
* * I hope soon, however, to produce something that will convince even the scepticism of great minds that a self-acting machine is not impossible; but that I may not lie under the charge of giving my ideas only in perspective, I will say this much, that the moving power I contemplate is to be produced by a pump, so constructed that the same power that will raise water ten feet high will raise it to any height required, even though it were ten thousand feet.

[Farther on, the Editor remarks on the above :—]

It seems rather obvious that "F. J." meant to say "the same self-acting principle," not precisely "the same power."

* Mec. Mag., vol. 1, p. 253.

5. ARCHIMEDEAN SCREW AND MERCURY.—A correspondent (vol. 1, 1823) thus describes his plan:—



A is the screw turning on its two pivots G G; B is a cistern to be filled above the level of the lower aperture of the screw with mercury (which I conceive to be preferable to water on many accounts, and principally because it does not adhere or evaporate like water); C is a reservoir, which, when the screw is turned round, receives the mercury which falls from the top; D is a pipe, which by the force of gravity conveys the mercury from the reservoir C on to (what, for want of a better term, may be called) the float-board E, fixed at right angles to the centre of the screw, and furnished at its circumference with ridges or floats to intercept the mercury, the moment and weight of which will cause the float-board and screw to revolve, until, by the proper inclination of the floats, the mercury falls into the receiver F, from whence it again falls by its spout into the cistern G, where the constant revolution of the screw takes it up again as before.

[After noticing the friction, &c., he adds :—]

To overcome this (the power of the fluid in the screw to turn it backwards), I thought of placing a metallic ball, or some mercury, on the ledge above the floats (as at H in the drawing), of just so much weight, and no more, as would exactly neutralize this backward endeavour; whether or no this would increase the difficulty of raising the mercury in the screw I cannot say, having never tried the experiment. * * * We all know the late Mr. Merlin's machine, consisting of two magnets poised upon their respective centres, and placed within the sphere of each other's influence, by which they were said to vibrate *in perpetuum;* but the general opinion at the time was, that some concealed mechanism was placed underneath, which, indeed, he himself never denied.

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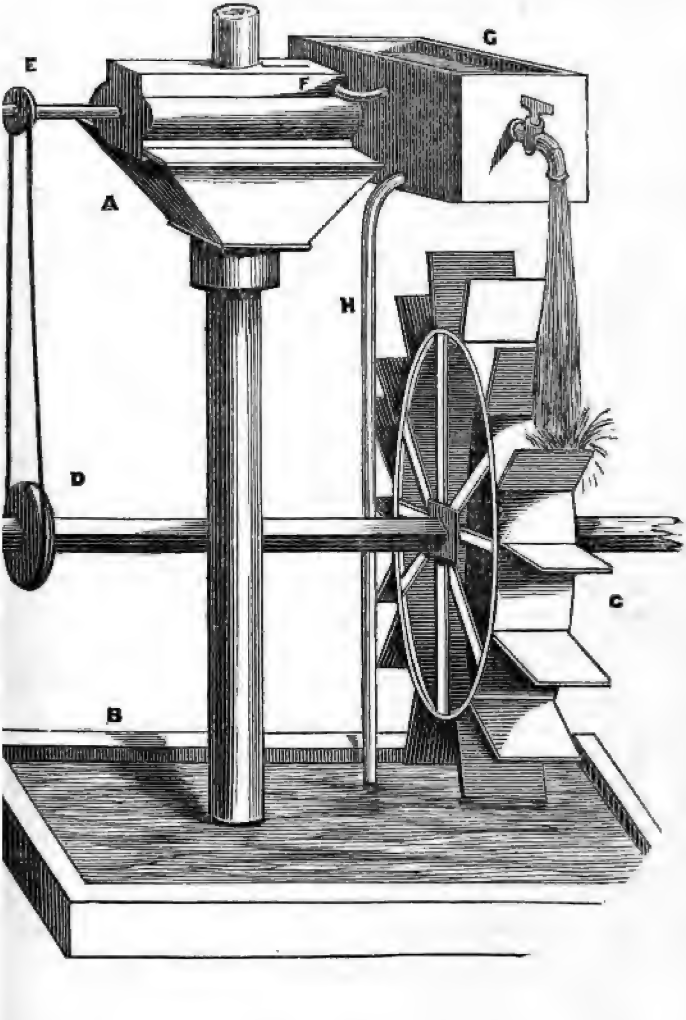
6. Plan of a Self-moving Machine (vol. 1, 1823):—

[A description of Rangely's Patent Roller Pump having appeared in the first volume, the writer proposes employing this pump, " which is represented as working with no more friction than what is occasioned by its revolution on its axis, viz., the revolution of a cylinder on its axis delivering water with a continual stream, &c., &c."]

I think it possible to produce a self-moving power by such a machine as that, a drawing of which is now prefixed. From its very simple construction, a very brief description is necessary. A represents a pump immersed in a reservoir B; the pump is worked by the rotatory motion of the water-wheel C, which is four feet in diameter. On the shaft of the water-wheel is the drum-wheel D, working by a small cord the wheel E, on the axis of the pump discharging the water by the pipe F into a reservoir G over the water-wheel. In this reservoir is a cock to regulate the quantity of water to be discharged on the wheel. The wheel on the shaft of the water-wheel being nine inches diameter, and the wheel on the axis of the pump three in diameter, the latter will consequently make three revolutions for one of the water-wheel. As the pump is not required to turn with great velocity, the speed might be regulated by the quantity of


E
G
F
A
H
D
C
B

water thrown on the water-wheel, the latter being four feet in diameter, and the wheel on its shaft nine inches; consequently the radius or arm of the wheel has near 4½ powers to counteract the friction of the axis of the pump and water-wheel, and of a fine cord passed over the wheels D and E. If necessary, the friction of the machine might be still farther reduced by the axes of the pump and water-wheel being made to run in gudgeons with friction rollers.

The pipe H is intended to convey the surplus water from the reservoir over the wheel to the reservoir below.

The pump might easily be turned by a cog-wheel; but this is unnecessary, as the cord passing over the drum-wheels will do equally well, and is, besides, a more simple method.

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7. Plan by Magnetism (vol. 4, 1825).—Its inventor writes:—

Let those laugh now who never laugh'd before;
Let those who ever laugh'd, now laugh the more.

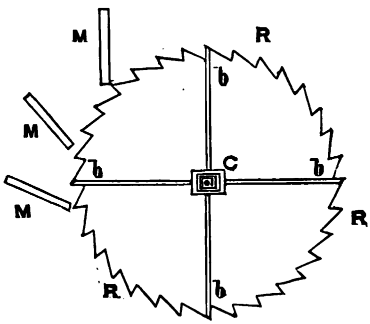
* * * *

You will agree with me that the universe is a display of perpetual motion, and that such a thing does, beyond all doubt, exist. The co-operation and nice combination of what or how many various causes (each perhaps governed by different laws, and opposite in their effects) which produce this perpetual motion, it might be presumptuous to endeavour to ascertain; suffice it to know, that all concur in a most wonderful manner to exhibit what man is striving to discover, and hitherto in vain.

I coincide in opinion with those who consider there are insurmountable difficulties to the discovery of perpetual motion by any machinery wholly subservient to the laws of gravity and the mechanical powers; and as the perpetual motion of the universe is not effected under the laws of gravity only, there appears but little probability of man's discovering it by such machinery.

By consulting nature's laws generally, success is more likely to follow; and, indeed, an invisible (but well-known) agency is available for the purpose. I have, therefore, re-

sorted to an auxiliary that operates wholly independent of, and in opposition to gravity, to effect perpetual motion; with what success you will see.



DESCRIPTION.—The above drawing represents a wheel of one foot in diameter, revolving on its centre C. Its circumference R R R is a thin steel hoop, or rim, three quarters of an inch broad, formed in the indented manner delineated, and connected to the centre by two bars *b b b b*. (The thin edge of the rim presents itself to view.)

M M M are three magnets fixed totally unconnected with the wheel. Their poles are placed as close as possible to its rim, but not to touch it, to impede its going round. These three magnets are so disposed as alternately to exert their full attractive powers, at right angles, on the flat indented surface of the steel rim of the wheel; and as it moves round, the attraction of one magnet does not cease its operation until another magnet exerts its full power.

The weight of the wheel on the side next the magnets being thus continually lifted, or rendered lighter, by the attraction of the magnets, causes the weight of the opposite side of the wheel to preponderate on its centre, and the wheel to revolve, and to continue a perpetual rotatory motion, at least as long as the magnets retain their attracting power.

8. Account of several Schemes (vol. 4, 1825). By F. Bell, who states that—

About five or six years ago, a young man, a Scotchman, of considerable ability, stumbled upon this attractive plan of producing a perpetual motion. Confident of the truth of his principle, and giddy with the dreams of riches which he had been told would await the happy inventor of this long-sought desideratum in mechanics, he gave up all his emoluments in Scotland, and hastened to London, for the purpose of getting his machine constructed in a superior manner. The workman he employed was a Mr. Allen, then resident in the neighbourhood of Fetter-lane. The principle he employed was exactly similar to that of your correspondent, but more complex in its application. After a lapse of some months, the machine was finished; and, with beating heart, the magnet was applied to produce effects which should astonish the world; but, alas! how shall I describe it? It was at that moment discovered that the magnetic influence was exerted equally to the right and left; and that, instead of the pieces of soft iron, disposed at equal distances round the circumference, being only pulled or attracted in one direction, they were equally acted upon in the opposite, and consequently no motion ensued.

It is about three years since that another person, also a native of North Britain, proposed a new power to propel carriages on the road and ships at sea, and exhibited a model of his engine in Burlington Arcade, Piccadilly. It consisted of a wheel moved (as he pretended) by this self-same principle of magnetism. The magnet, of a spherical form, was placed on a plate of metal, or, rather, mixture of metals (as he said), which had the rare power of intercepting the magnetic attraction, and consequently preventing the re-action which was fatal in the other case. I believe Mr. Gill took the trouble to expose this pretender in his "Technical Repository."*

I had an opportunity, some time ago, of reading a letter from a person who had witnessed a similar invention, made by a Mr. John Spence, shoemaker, at Linlithgow, also in "Scotland's Isle." It consisted of a needle nicely balanced

* See Chapter VI., p. 184.

on a pivot, which was kept in continual motion by its poles being alternately attracted by two magnets, properly placed, and whose attraction was regularly cut off through the intervention of intercepting substances, which Mr. Spence was represented as having spent twenty or thirty years in finding out.*

It was also stated that he was at that time constructing an apparatus applicable to time-keepers, which he was going to present to the Royal Society, but, not having since heard of him or his intended communication to that learned body, I am afraid that Death has stepped in, and *intercepted* him in his laudable pursuits.

* * * * *

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9. SPENCE'S PERPETUAL MOTION (vol. 4, 1825):—

* * About two years since, a person named Haigh (a native, I believe, of Yorkshire) called on me with what he called a "perpetual motion." I inquired why he did not present it to some learned body in London, instead of travelling with it as an exhibition. He replied that, as he was not himself the inventor, he was afraid he should not be attended to. He said it was invented by the late Mr. John Spence, of Linlithgow, near Edinburgh, who, being on his journey to London to present it to the Royal Society, was taken ill in some part of Yorkshire, where, after a lingering illness, he died; and that he bequeathed the machine to him in gratitude for the assistance he had received from him during his illness. The construction of the machine was as pointed out by Mr. Bell, with this difference:—the needle was attached to a brass balance, about the size and weight of the balance of a watch, beyond the edge of which it projected. He suffered me, after having witnessed its swift rotatory motion for about half an hour, to remove the balance, &c., from the frame in which it acted, when I found the pivot and holes very much worn, which convinced me it must have been in action a considerable time (he said it had, nearly six years). On replacing it, and blowing slightly against the edge of the balance, it instantly commenced its action as before, *i.e.*, with the same steady velocity, making about one hundred and

* See pp. 182, 226.

sixty revolutions in a minute, which I again witnessed a considerable time; nor did Haigh appear the least impatient to put an end to the gratification I was experiencing.

The following extract of a letter from Capt. Bagnold, R.M., Member of the Society of Arts, Haigh left with me:—

"Liverpool, May 2, 1820.

"Having inspected Mr. S. Haigh's exhibition of a magnetic perpetual motion, I prevailed upon him to permit the approach of a powerful horse-shoe magnet, the property of Mr. Byewater, of this town. When in contact with the glass on one side, it produced no very striking alteration; when held perpendicularly over the case, it appeared rather to accelerate the revolution of the needle; but when removed to the opposite side, its effect was instantly visible,—the needle was suddenly checked, and seemed to recover its motion by successive impulses. From the foregoing circumstances, I am clearly of opinion Mr. Haigh's exhibition is a fair specimen of perpetual motion by magnetic influence, and the experiment has totally banished from my mind all suspicion of deception; and I strongly recommend Mr. Haigh by no means to repeat the experiment, lest injury should accrue to so ingenious an invention."

Sir, yours, &c.,

Richard Price, Watchmaker and Silversmith.

Wiveliscombe, Somerset, June 13, 1825.

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10. Perpetual Motion on Philosophical Principles (vol. 4, 1825):—

The following is copied from a foreign work: should you consider it worthy publication, it is much at your service.

R. W. Dickinson.

"The power is at present applied to the machinery of a clock; this clock, unconnected with the power, is calculated to go for two years without winding up, by the weight of a single pound, that gives motion to a pendulum of twenty pounds, which moves through a space of 518·400 inches in twenty-four hours, while the small maintaining weight (a single pound) descends only 1-10th of an inch. The internal work of the clock consists of three wheels. In order that the superiority of this movement may be obvious to every understanding, as well as to those more conversant with the

more difficult parts of mechanics, it is necessary to mention that the common eight-day clock requires a weight of fourteen pounds, where this only requires the weight of one, is wound up once in eight days, and moves a pendulum of three pounds and a half, where this moves one of twenty, and is wound up only once in two years. In twenty-four hours, the maintaining weight of the common clock descends six inches, in this it descends only 1-10th of an inch. The least weight which we at present recollect to have heard of being used by the first artist in London is five or six pounds, where this requires only one, in consequence of the diminution of friction. So far it has been thought necessary to describe this clock in comparison with the common one.

"We now come to that part to which extraordinary merit is to be ascribed—the faculty of winding itself up without the intervention of human power. This faculty is derived from the weight of the atmosphere, and can never cease (under the conditions after mentioned) while the machine lasts, and while a column of air either loses or gains 1-150th part of its common weight five times in the space of two years, the time which the clock goes without requiring any assistance; or, in other words, as long as the change of the weight of the air, five times in the space of two years, shall be such as to cause the mercury either to ascend or fall 2-10ths of an inch in the barometer above or below its mean height. The wearing out of wheels, or of any kind of machinery, by friction, never can be avoided; accordingly, it has never been required in the discovery of a perpetual motion. It is therefore sufficient, on that subject, to say that the present machine, upon a fair comparison of its friction with that of the common clock, would probably move five centuries, a period sufficient for any purpose that can be required."

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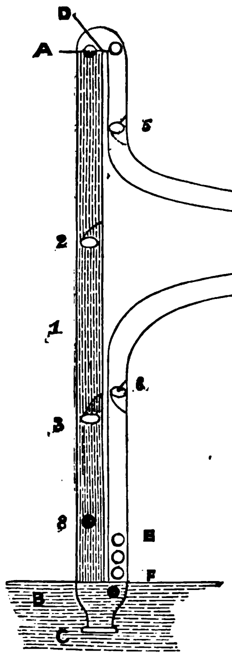
11. A Hydro-pneumatic Plan.—A correspondent (vol. 4, 1825) says:—

The unsuccessful (but far from fruitless) search made to discover the "philosopher's stone," and the "elixir vitæ," were productive of most important and beneficial results in the kingdom of chemistry; so, by a parity of consequence, I am disposed to believe that, from enquiry after the "perpetual

motion" (though equally unsuccessful), a similar good will result to the mechanical world. * * I beg leave to offer the prefixed device. The point at which, like all the rest, it fails, I confess I did not (as I do now) plainly perceive at once, although it is certainly very obvious. The original idea was this—to enable a body which would float in a heavy medium and sink in a lighter one, to pass successively through the one to the other, the continuation of which would be the end in view. To say that valves cannot be made to act as proposed will not be to show the *rationale* (if I may so say) upon which the idea is fallacious.



The figure is supposed to be tubular, and made of glass, for the purpose of seeing the action of the balls inside, which float or fall as they travel from air through water and from water through air. The foot is supposed to be placed in

water, but it would answer the same purpose if the bottom were closed.

DESCRIPTION OF THE ENGRAVING.—No. 1, the left leg, filled with water from B to A. 2 and 3, valves, having in their centres very small projecting valves: they all open upwards. 4, the right leg, containing air from A to F. 5 and 6, valves, having very small ones in their centres: they all open downwards. The whole apparatus supposed to be air and water-tight. The round figures represent hollow balls, which will sink one-fourth of their bulk in water (of course will fall in air); the weight, therefore, of three balls resting upon one ball in water, as at E, will just bring its top even with the water's edge; the weight of four balls will sink it under the surface until the ball immediately over it is one-fourth its bulk in water, when the under ball will escape round the corner at C, and begin to ascend.

The machine is supposed (in the figure) to be in action, and No. 8 (one of the balls) to have just escaped round the corner at C, and to be, by its buoyancy, rising up to valve No. 3, striking first the small projecting valve in the centre, which, when opened, the large one will be raised by the buoyancy of the ball; because, the moment the small valve in the centre is opened (although only the size of a pin's head), No. 2 valve will have taken upon itself to sustain the whole column of water from A to B. The said ball (No. 8) having passed through the valve No. 3, will, by appropriate weights or springs, close; the ball will proceed upwards to the next valve (No. 2), and perform the same operation there. Having arrived at A, it will float upon the surface three-fourths of its bulk out of water. Upon another ball in due course arriving under it, it will be lifted quite out of the water, and fall over the point D, pass into the right leg (containing air), and fall to valve No. 5, strike and open the small valve in its centre, then open the large one, and pass through; this valve will then, by appropriate weights or springs, close, the ball will roll on through the bent tube (which is made in that form to gain time as well as to exhibit motion) to the next valve (No. 6), where it will perform the same operation, and then, falling upon the four balls at E, force the bottom one round the corner at C. This ball will proceed as did No. 8, and the rest in the same manner successively.

12. F. Bell's Endless Band with Cork Floats (vol. 4, 1825).—After commenting on perpetual motion schemes, he says:—

I certainly consider the idea of gaining a perpetual motion by the passing of bodies through mediums of different densities is a very ingenious one, as it is the same in effect as if the specific gravity of the moving bodies was a variable quantity, which agrees very well with the definition of De la Hire—viz., to find a body heavier and lighter than itself.

[He then gives the following as a better plan:—]

Let an endless chain or rope be passed over a pulley, and through a hole of similar diameter made in the bottom of a vessel filled with water, so that one half of the rope will always be in the water, and the other half in air. Now, let this chain or rope be divided into equal links or divisions, and constructed in the following manner:—Let pieces of cork, or any other light substance, be attached to the rope exactly in the same manner as the whalebones are fastened to the stick of an umbrella, so that they may form a complete cylinder, when passing through the hole in the bottom of the vessel, and prevent the water from rushing out; but the moment one of these links gets through the hole (which will be immediately filled by another) these pieces of cork will radiate, or fly out, like the spokes of a wheel, and exert a force proportionate to their lightness, to ascend to the top of the vessel, and thus give motion to the machine.

* * * * *

Although it is my opinion that the "Century of Inventions" has been the means of forming many a mechanical mind, by creating a spirit of enquiry after those subjects, yet I also believe it has fallen into the hands of few persons who have not from that time become determined perpetual-motionists; for, if we can place any reliance upon the invention No. 56, which seems so well attested, the Marquis was undoubtedly in the secret. The plan which most people adopt, who would accomplish the point by means of weights, is, I dare say, familiar to most of your readers—viz., by means of falling levers, a description of which may be seen in the "Mathematical Recreations," translated by the late Dr. Hutton; but, as the Doctor observes, "it may be easily shown that there is one position of the wheel in which the

system is in equilibrium, and consequently will stop:" the plan may therefore be given up as untangible. I have seen and read of many attempts to overcome this obstacle by means of springs, &c., but they have been attended with no better success. I am, however, in possession of a method of constructing the machine so that "all the weights on the descending side of the wheel shall be perpetually further from the centre than those of the mounting side," by which arrangements there seems to be an equilibrium in every position of the wheel.

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13. Another Band with Cork Floats.—A correspondent (vol. 4, 1825) states that he attempted a continued motion precisely on the foregoing plan. He says:—

The experiment I made was with a number of corks, strung at intervals for the purpose, and passed through an aperture in the bottom of a glass vessel, to which they were fitted. As might be expected, the weight of the column of water over the aperture was superior to the buoyancy of the corks, and upon their being pressed upwards they were forced back again to the aperture. This to me was sufficient, for the expansion of these corks in the manner described by Mr. Bell would, it appeared to me, not in the least increase their buoyancy, unless their bulk could also be increased at the same time.

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14. Perpetual Motion Discovered; or, a Plan by which a Vessel may be made to continue in powerful motion, without any assistance, as long as her materials endure (vol. 5, 1825).—The inventor states:—

The principle on which I depend is the well-known law in hydrostatics, that the pressure of water is the same at the same depth, whatever may be the diameter of the vessel that contains it.

Let a boat be constructed, having a bottom as flat as possible. Let two parallel boards (each of equal dimensions with the bottom of the boat) be strongly connected together, having an interval between them of about an inch. By a contrivance similar to that which unites the upper with the

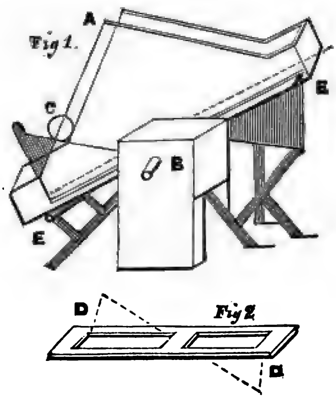
lower board of a common bellows, affix these boards, thus connected, to the bottom of the boat, in such a manner that they may be readily susceptible of an alternate ascending and descending motion, in a space of about two or three feet in height, to which water must have no access. In the centre of these boards, or of this moveable frame, fix a strong iron rod, extending upwards through the boat, and attached to the machinery for working the paddles. In the upper part of the moveable frame make a small aperture, to which firmly secure a narrow tube, extending upwards through a hole in the bottom of the boat. At the bottom of this tube let there be a sliding valve, which by a very simple contrivance can be closed the very moment that the frame reaches its greatest distance from the bottom of the boat, and as speedily re-opened when the frame comes in contact with the boat. Through this narrow tube pour water into the moveable frame, until both it and the tube are full. The space between the frame and the bottom of the boat must be always free from water. The vessel now is ready for action. Let us suppose that, owing to the upward pressure of the sea, the frame is now in contact with the bottom of the vessel; to remove it to its greatest distance from the vessel, nothing more is required (according to the above principle in hydrostatics) than an altitude of water within the narrow tube a little greater than the level of the sea; or, if the tube be not sufficiently long, a weight pressing on the water within the tube equal to the weight of a column of water of the required altitude, will be equally efficient, and far more convenient. If the valve be opened, this altitude of water will be applied, and the frame will then be forced to its greatest distance from the bottom of the vessel, and will then, consequently, have closed the valve. The valve being closed, the pressure of the water in the tube is no longer continued on the sheet of water within the moveable frame, so that the sea will then, with a power nearly equal to the weight of the vessel, force the frame upwards with the iron rod affixed to it, and thereby set the machinery and paddles in vigorous motion, and impel the vessel either against the tide or in any other direction which may be required. When the frame comes again into contact with the bottom of the vessel, the valve is again opened—the water in the tube again presses on that within the frame—

the frame again descends; and thus it will continue *ad infinitum*, without any assistance whatever.

[He proposes placing it in a "circular channel."]

15. Perpetual Pump (vol. 5, 1825).—Its inventor says:—

The description of the perpetual pump has suggested to me whether the long-sought "perpetual motion" may not be found by a simple mechanical alteration of that machine, and substituting a cannon-ball as a *primum mobile*, in lieu of the water, not always obtainable. I would recommend that in the bottom of the trough be inserted, at each end, two dropping-boards, of a triangular form, moving on an axis at one corner, one of which falling below the level of the trough at the elevated end, the other shall be raised by the stop affixed to the standard-post, which, throwing the ball again back to the former end, shall depress that, until the same process is repeated in perpetual activity.



Description.—Fig. 1. A, the trough, swinging on an axis at B. C, the cannon-ball, raised by one of the dropping-boards, D, whilst the other falls through the opening at E, into the trough. F, the support or stop, raising the dropping-board D. The centre of the trough ought to be pierced,

leaving the sides as a support to the ball, which ought not to be wider than the ball may travel freely through.

Fig. 2. DD, the dropping-boards, which pass through the centre, so as to leave a sufficiency of the trough as a resting-place for the ball to give a momentum, and depress the trough, previously to its being again raised by the dropping-board.

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16. Perpetual Clock (vol. 5, 1826).—A correspondent says:—

Allow me to state that six or seven years ago I saw part of an apparatus which I was informed had been at work two years, and then taken to pieces. It was a pendulum clock, the spring of which was wound up by the rising and falling of the mercury, acted on in two tubes by the atmosphere, every variation of which, whether it tended to rise or depress the mercury, still acted the same way on the spring.—T. N.

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17. Ancient Attempt at Perpetual Motion (vol. 5, 1825):—

The underwritten is translated from an ancient Latin book * * * (entitled "De Simia Naturæ," Autore Roberto Fludd),* which treats of every science known at the time it was published, and largely of the science of mechanics. What follows I have extracted merely to show that the discovery of the perpetual motion was as nearly attained then, perhaps, as it is now.—I am, &c., P.

Of another useful invention for raising water easily, by the which a certain Italian ventured to boast that he had discovered the Perpetual Motion.

Description of the Instrument.—A is an exhauster, or pump.

B, a little wheel placed at the bottom of the exhauster, about which pestils, or circular flaps of prepared leather, revolve lightly, so that they rise easily: they are connected by crooked iron.†

* See Chapter I., p. 28.

† Bent iron wire, I imagine, by the plate.

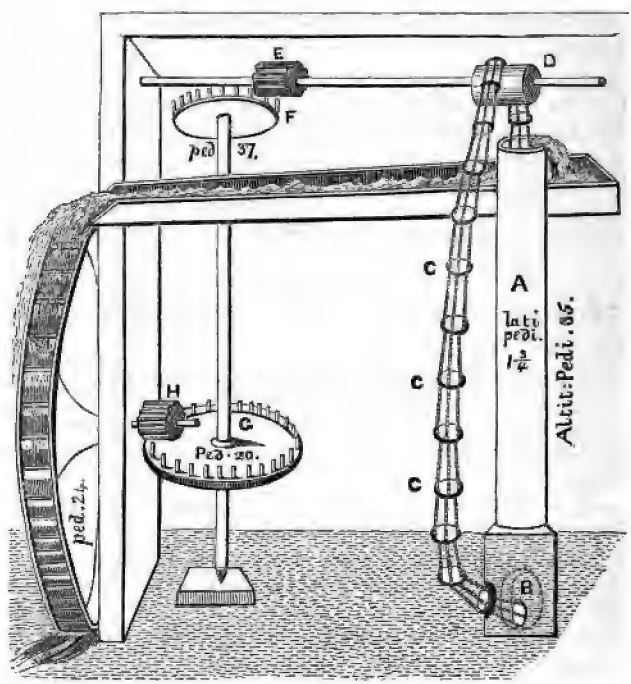
C C C, pestils, or circular leathers, by means of which the water is raised in the pump.

D, a wheel, by which the said circular leathers are raised up.

E, a pinion, moving the wheels D and B.

F is a wheel, continued from the wheel G, whose teeth the pinion E propels circularly.

H, a pinion moving the wheel G.



USE OF THE INSTRUMENT.—This instrument is classed with those of the first sort,* on which account it is absolutely necessary for a multitude of purposes, because it bears

* In reference to previous rules.

upward a large quantity of water with the least labour; for the number of wheels is not variable; but the length of the receiver A is about the proportion of 35 feet, and its breadth one foot and one-third. The concavities of it should be made exactly round, that they* may not lose any water by contracting in their ascension; the concavity of the pump, therefore, should be perfectly round. The great-water-wheel should be 24 feet diameter, and the wheel G 20 feet.

The Italian, deceived by his own thoughts, conceived that as much water would be raised by this pump as would keep the wheel perpetually in motion; because he said that more force was required at the extremity of this machine than at the centre;† but because he calculated the proportions of power wrong, he was deceived (undeceived) in practice.

This last remark is a dose for many perpetual motion seekers.

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18. ORCHARD'S VACUUM ENGINE (vol. 6, 1826).—He considers the following a great improvement on a plan he had formerly suggested. It is meant to be a self-supplying engine:—

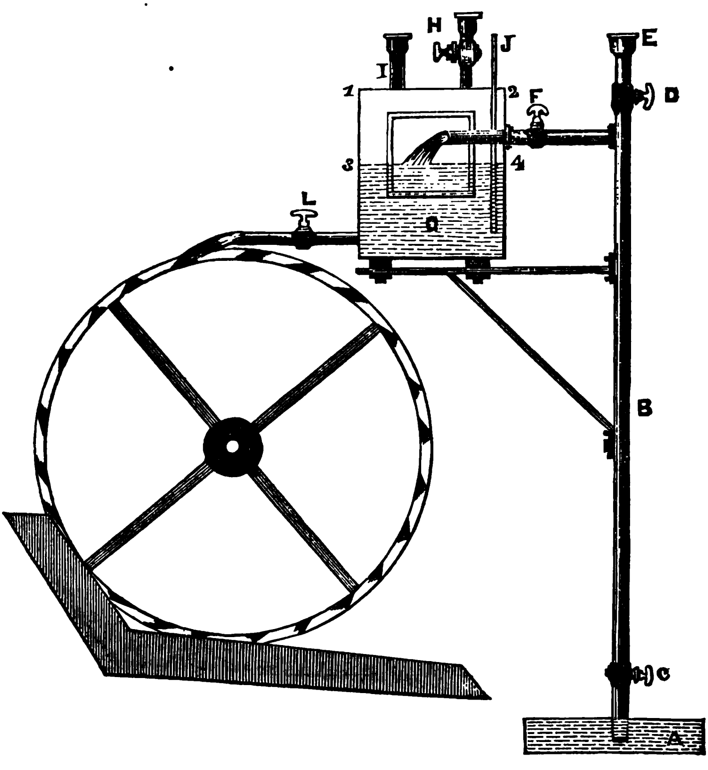
A is an iron reservoir nearly filled with mercury; B, a tube twenty-four inches long, having its lower end inserted in that reservoir; and C and D two cocks for the convenience of filling the tube B. From this tube another tube M proceeds at right angles, to the vessel G. In this latter tube is the cock F, to admit of, or shut off, a communication between the tube and the vessel G. This communication being closed, the tube B is carefully filled with mercury; after which, the cock D is closed, and the cap E screwed on.

The vessel G is to be filled with mercury through the cock H, the pipe I being open to allow of the escape of air. When this vessel has been filled, the cock H should be closed, and its cap screwed on; and the pipe I be also closed by a valve, which is to be pressed tight by the cap on the head of the pipe. I is a vent-pipe, open at the top. The space represented by the double lines is a panel of thick plate glass,

* The circular leathers.

† The pump?

having two horizontal lines described on its surface, whereby the attendant may observe the quantity of mercury within the vessel.



The cock F being closed, a quantity of mercury must be allowed to run out of the vessel G, equal to the space 1, 2, 3, 4, which space will become a vacuum. If, therefore, the cock L be then opened, to allow of the discharge of a certain quantity of mercury on the wheel, and the cocks C and L also opened, the mercury will continually rise from the reservoir A into the vessel G, and thence be discharged on

the wheel, whence it will again fall into the vessel A, to keep up the supply. The cock F must be so adjusted as to admit into the vessel G a quantity of mercury equal to that which is discharged by the cock L. This can be ascertained and regulated by means of the panel of glass above described.

The specific gravity of mercury being $7\frac{1}{2}$ ounces, it is evident that but a small quantity of it is required to turn the wheel, which has no friction but that of the axis on which it turns.

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19. A Perpetual Motion at Stutgartt (vol. 6, 1826).—A correspondent writes:—

I beg to take this opportunity of stating my knowledge of the truth of perpetual motion having been accomplished by magnets placed round a circular box, enclosing a steel-vaned wheel, and also that there is now a machine incessantly at work, without assistance, in the famous library at Stutgard, by which a bar (hung by a pivot through the middle) in an upright position, between two pillars, with a ball at each end, the top one being a little heavier than the one below, continues to vibrate by the top ball alternately falling upon and rebounding from each pillar. How this is performed I am ignorant, as the person who saw it and described it to me did not examine it with the eye of a machinist, but was merely eye-witness to the effects.

[He begs the favour of a description and drawing.]

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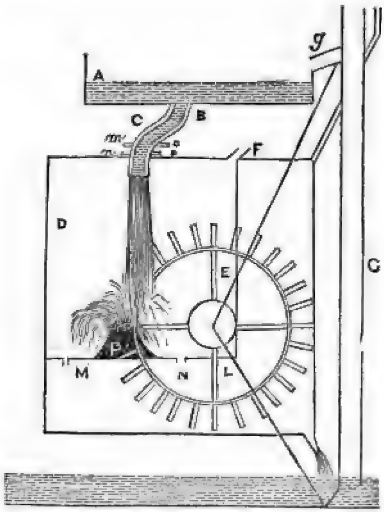
20. Water Blowing Machine applied to the Production of Perpetual Motion (vol. 7, 1827).—The inventor writes:—

I am encouraged to send you the following attempt at perpetual motion, because I think it is upon a principle that has not yet been examined in your pages.

In Dr. Brewster's appendix to Ferguson's Lectures, the following description is given of what is called a "Water Blowing Machine:"—"Let A B (see Fig.) be a cistern of water, with the bottom of which is connected the bended leaden pipe B C H. The lower extremity, H, of the pipe is

inserted into the top of a cask or vessel, D E, called the condensing vessel, having the pedestal P fixed to its bottom, which is perforated with two openings, M N. When the water which comes from the cistern A is falling through the part, C H. of the pipe, it is supplied by the openings or tubes, *m n o p*, with a quantity of air which it carries along with it.



This mixture of air and water, issuing from the aperture H, and impinging upon the surface of the stone pedestal P, is driven back and dispersed in various directions. The air being thus separated from the water, ascends into the upper part of the vessel, and rushes through the opening, F, whence it is conveyed to the fire, while the water falls to the lower part of the vessel, and runs out by the openings M N." The author then goes on to describe the construction of the pipe B C H, in the curve of which some nicety is required, and to explain some atmospherical phenomena upon the principle of this machine, adding that " Franciscus Tertius de Lanis observes that he has seen a greater wind generated by a blowing machine of this kind than could be produced by bellows ten or twelve feet long."

Now, if, instead of the pedestal P, a wheel were placed in the condensing vessel, as in the figure, would not the water, in falling upon the wheel, be sufficiently dispersed to disengage the air at the same time that it drove the wheel, and would not the motion of the wheel be retarded by the density of the internal air?

I do not apprehend that any considerable resistance would be offered by the internal air, and the motion of the wheel can be regulated by its load, so as to offer a sufficient resistance to the descending stream of water; and I therefore assume that the water, in its descent, would produce, by means of the wheel, a power capable of raising a part of the water expended back again to the cistern; and this is the extent of the power of most of those machines which have been mistaken for perpetual motions by their projectors. But I have a blast of wind which is described as being of great force. Can this blast be in any way applied to raise the surplus water? I think I see the smile which the proposal will produce in those who deny the possibility of a perpetual motion. "A mere puff of wind!" is, doubtless, ejaculated from all sides. But, let me tell these gentlemen that, though I may not know any method by which such blast can produce that effect, it does not by any means follow that the impossibility of the thing is thence to be presumed. Far from it; for such a conclusion rests upon the supposition that the powers and application of a blast of wind are fully known, and that no research or experience can add to our knowledge on that subject—assumptions which appear to me somewhat ridiculous. Allow me, for the sake of argument, to suppose that this blast, instead of wind, had been a blast of steam. Time was, when wise men would have smiled, and said, "A puff of steam—a mere puff of steam!"—and had some one, more sanguine than the rest, attempted, by its application, to produce a motion, he would have applied it to the float-boards of a wheel, as in Branca's engine, and have been disappointed. It is not given to man to know when the powers of any great agent have been fully developed; and those who act upon such presumptions throw the greatest obstacles in the way of enquiry. But, to shew the anti-perpetualists that within their own time, since the commencement of the "Mechanics' Magazine," an addition has been made to our knowledge of the powers of a blast of wind, I have added a

tube, G, to my figure, the proposed use of which I shall now describe.

In a part of the "Mechanics' Magazine," published some time ago, there was described a novel mode of raising water in a tube,* by directing a stream of air over its mouth, thereby destroying the pressure of the atmosphere.

[He asks the author of this experiment "to what height he has raised water by this means."]

I do not suppose it will rise to the height of the cistern as I have figured it; but it may still be a question whether it may not be accomplished by a series of short tubes, the bottom of the one being placed in the cistern into which the next below discharges its water, each being constructed with a blast and two valves, in the same manner as the single tube—namely, the valves x (under water) and y, worked in such a manner, by the arms K L, that the one may shut when the other opens. Presuming that the water will rise to the top of the tube, when the blast is in action (x open and y shut), the water in the part of the tube between the blast and y will be discharged into the cistern at the next motion of the valves—namely, when x is shut and y opened, the blast, at the same time, being discontinued.

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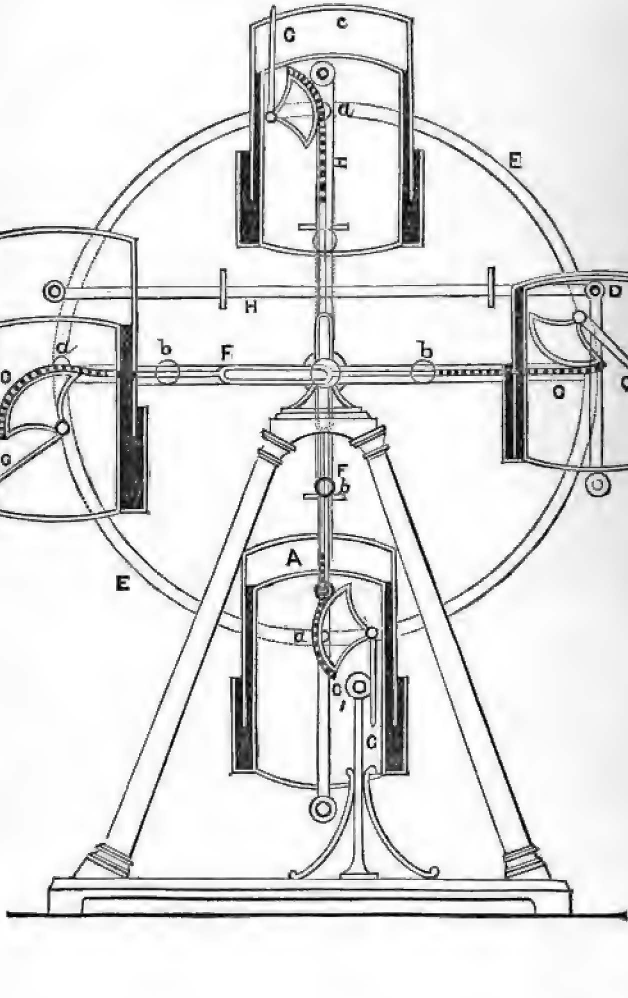
21. EDITORIAL NOTE, and Letter on Perpetual Motion (vol. 7, 1827):—

[The subject of perpetual motion having been recently again brought under discussion in our pages, our impartiality and candour have been appealed to for the insertion of the following plan. * * There is always one advantage attending the publication of even the most absurd schemes of this kind, that they produce refutations which serve to make the true principles of mechanics better and better understood among ingenious men, and to induce numbers silently to abandon the prosecution of plans equally absurd, and equally cherished with the fondest regard.—ED.]

* * * * * *

Amid all the fruitless attempts which have appeared, there

* Rather, the short leg of a syphon, by blowing with a pair of bellows.



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was still one avenue to the object of pursuit overlooked, to which the common and well-known principles of hydrostatics seemed to direct the way: this was the principle that any body specifically, or bulk for bulk, lighter than common air, will rise and swim in it. Consequently, if I attach a certain quantity of vessels, at equal distances, round the circumference or rim of a wheel, so contrived as that one half of the vessels shall be exhausted on one side of the wheel, and the other half filled with air on the opposite side, in this case the exhausted vessels will attain the highest part of the wheel, and the full ones the lowest. But to render the matter more explicit, I must refer to the prefixed drawing.

A B C D are four vessels, connected to the wheels E E (though only one is shewn, to prevent confusion) by round pins, *a a a a*, which project from the vessels on each side, and enter into corresponding holes in the wheels E E. The wheels E E are caused to revolve by the space under the vessel B being a vacuum, and therefore lighter than the same portion of air: a little before the vessel B reaches the highest point of the wheels, it begins to close, and opens the opposite vessel D, in the same manner as the vessel C opens A, because the pressure of the atmosphere on the vessel C is equal to the pressure on A. Instead of common packing to make the vessels air-tight, mercury is substituted, which has infinitely less friction, and is never out of order: it is represented by the black marks in the drawing. The particles of mercury not being entirely free from friction, a little power is requisite to open and shut the vessels; this is effected by the rods F F, connected to the levers G G G G by chains. The rods F F give motion to other rods, H H, by the rollers *b b b b* acting against the collars on the rods H H. Again, the levers G G G G are successively worked by sliding over the roller P. The connecting-rods H H are so adjusted as not to draw the vessels out of their upright position, which would let the mercury escape; also, the lower vessels A and D are made rather larger in diameter than B C, so as the pressure of the atmosphere may counterpoise the weight of the vessels A C and B D, with their connecting-rods, &c.

I doubt not in the least, that if a pneumatic machine like this were accurately executed, it would continue in perpetual motion; yet I still think the power might be greatly increased by placing the whole engine under a receiver of condensed

air, say from ten to twelve atmospheres, which would weigh, if it were ten atmospheres, about twelve ounces per cubic foot.

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22. SCHEME OF PERPETUAL MOTION (vol. 7, 1827). By Sir W. Congreve, Bart.—The following article is from the "Atlas:"—

The celebrated Boyle entertained an idea that perpetual motion might be obtained by means of capillary attraction; and, indeed, there seems but little doubt that nature has employed this force in many instances to produce this effect.

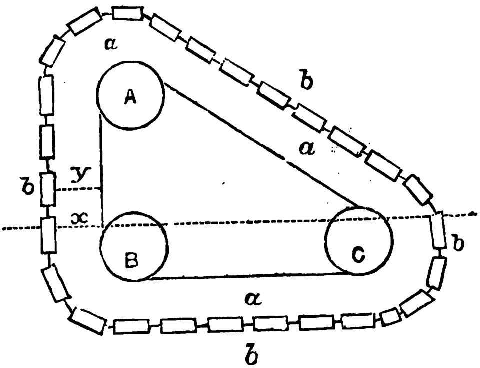
There are many situations in which there is every reason to believe that the sources of springs on the tops and sides of mountains depend on the accumulation of water created at certain elevations by the operation of capillary attraction, acting in large masses of porous material, or through laminated substances. These masses being saturated, in process of time become the sources of springs and the heads of rivers; and thus, by an endless round of ascending and descending waters, form, on the great scale of nature, an incessant cause of perpetual motion, in the purest acceptance of the term, and precisely on the principle that was contemplated by Boyle. It is probable, however, that any imitation of this process on the limited scale practicable by human art would not be of sufficient magnitude to be effective. Nature, by the immensity of her operations, is able to allow for a slowness of process which would baffle the attempts of man in any direct and simple imitation of her works. Working, therefore, upon the same causes, he finds himself obliged to take a more complicated mode to produce the same effect.*

To amuse the hours of a long confinement from illness, Sir William Congreve has recently contrived a scheme of perpetual motion, founded on this principle of capillary

* A familiar instance of a continuous round of interchanging cause and effect, produced by this capillary process, and limited only by the duration of the materials, is furnished by a common candle. The flame melts the wax or tallow, which, ascending the fibres of the wick, keeps that flame alive; so that, literally speaking, the flame is the active cause of its own existence,—a sort of paradox, precisely similar to that which our perpetual motion seekers have so long been vainly endeavouring to realize.—ED. "Mec. Mag."

attraction, which, it is apprehended, will not be subject to the general refutation applicable to those plans in which the power is supposed to be derived from gravity only. Sir William's perpetual motion is as follows :—

(*Fig.* 1.)



Let A B C be three horizontal rollers fixed in a frame; *a a a*, &c., is an endless band of sponge, running round these rollers; and *b b b*, &c., is an endless chain of weights, surrounding the band of sponge, and attached to it, so that they must move together; every part of this band and chain being so accurately uniform in weight that the perpendicular side A B will, in all positions of the band and chain, be in equilibrium with the hypothenuse A C, on the principle of the inclined plane. Now, if the frame in which these rollers are fixed be placed in a cistern of water, having its lower part immersed therein, so that the water's edge cuts the upper part of the rollers B C, then, if the weight and quantity of the endless chain be duly proportioned to the thickness and breadth of the band of sponge, the band and chain will, on the water in the cistern being brought to the proper level, begin to move round the rollers in the direction A B, by the force of capillary attraction, and will continue so to move. The process is as follows :—

On the side A B of the triangle, the weights *b b b*, &c., hanging perpendicularly alongside the band of sponge, the

band is not compressed by them, and its pores being left open, the water at the point x, at which the band meets its surface, will rise to a certain height, y, above its level, and thereby create a load, which load will not exist on the ascending side C A, because on this side the chain of weights compresses the band at the water's edge, and squeezes out any water that may have previously accumulated in it; so that the band rises in a dry state, the weight of the chain having been so proportioned to the breadth and thickness of the band as to be sufficient to produce this effect. The load, therefore, on the descending side A B, not being opposed by any similar load on the ascending side, and the equilibrium of the other parts not being disturbed by the alternate expansion and compression of the sponge, the band will begin to move in the direction A B; and as it moves downwards, the accumulation of water will continue to rise, and thereby carry on a constant motion, provided the load at $x\ y$ be sufficient to overcome the friction on the rollers A B C.

Now, to ascertain the quantity of this load in any particular machine, it must be stated that it is found by experiment that the water will rise in a fine sponge about an inch above its level; if, therefore, the band and sponge be one foot thick and six feet broad, the area of its horizontal section in contact with the water would be 864 square inches, and the weight of the accumulation of water raised by the capillary attraction being one inch rise upon 864 square inches, would be 30 lbs., which, it is conceived, would be much more than equivalent to the friction of the rollers.

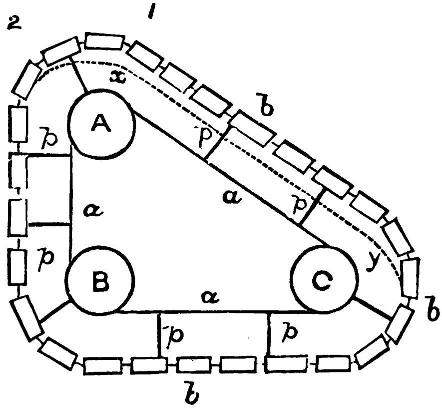
The deniers of this proposition, on the first view of the subject, will say, it is true the accumulation of the weight on the descending side thus occasioned by the capillary attraction, would produce a perpetual motion, if there were not as much power lost on the ascending side by the change of position of the weights, in pressing the water out of the sponge.

The point now to be established is, that the change in the position of the weights will not cause any loss of power. For this purpose, we must refer to the following diagram.

With reference to this diagram, suppose *a a a*, &c., an endless strap, and *b b b*, &c., an endless chain running round the rollers; A B C not having any sponge between them, but kept at a certain distance from each other by small and

inflexible props, *p p p*, &c., then the sides A B and C A would, in all positions of this system, be precisely an equilibrium, so as to require only a small increment of weight on either side to produce motion. Now, we contend that this equilibrium would still remain unaffected, if small springs were introduced in lieu of the inflexible props *p p p*, so that

(*Fig.* 2.)



the chain *b b b* might approach the lower strap *a a a*, by compressing these small springs with its weight on the ascending side; for although the centre of gravity of any portion of chain would move in a different line in the latter case—for instance, in the dotted line—still the quantity of the actual weight of every inch of the strap and chain would remain precisely the same in the former case, where they are kept at the same distance in all positions, as in the latter case, where they approach on the ascending side; and so, also, these equal portions of weights, notwithstanding any change of distance between their several parts which may take place in one case and not in the other, would in both cases rise and fall, though the same perpendicular space, and consequently the equilibrium, would be equally preserved in both cases, though in the first case they may rise and fall through rather more than in the second. The application of

this demonstration to the machine described in Fig. 1, is obvious; for the compression of the sponge by the sinking of the weights on the ascending side, in pressing out the water, produces precisely the same effect as to the position and ascent of the weights, as the approach of the chain to the lower strap on the ascending side, in Fig. 2, by the compression of the springs; and consequently, if the equilibrium is not affected in one case—that is, in Fig. 2, as above demonstrated—it will not be affected in the other case, Fig. 1; and, therefore, the water would be squeezed out by the pressure of the chain without any loss of power. The quantity of weight necessary for squeezing dry any given quantity of sponge must be ascertained and duly apportioned by experiment. It is obvious, however, that whether one cubic inch of sponge required one, two, or four ounces for this purpose, it would not affect the equilibrium, since, whatever were the proportion on the ascending side, precisely the same would the proportion be on the descending side.

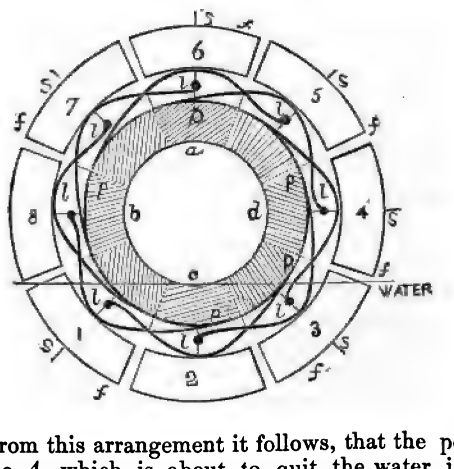
This principle is capable of application in various ways, and with a variety of materials. It may be produced by a single roller or wheel. Mercury may also be substituted for water, by using a series of metallic plates instead of sponges; and, as the mercury will be found to rise to a much greater height between these plates, than water will do in a sponge, it will be found that the power to be obtained by the latter materials will be from 70 to 80 times as great as by the use of water. Thus, a machine, of the same dimensions as given above, would have a constant power of 2000 lbs. acting upon it.

We now proceed to shew how the principle of perpetual motion proposed by Sir Wm. Congreve may be applied upon one centre instead of three.

In the following figure, *a b c d* represents a drum-wheel or cylinder, moving on a horizontal axis surrounded with a band of sponge 1 2 3 4 5 6 7 8, and immersed in water, so that the surface of the water touches the lower end of the cylinder. Now then, if, as in Fig. 2, the water on the descending side *b* be allowed to accumulate in the sponge at *x*, while, on the ascending side D, the sponge at the water's edge shall, by any means not deranging the equilibrium, be so compressed that it shall quit the water in a dry state, the accumulation of water above its level at *x*, by the capillary attraction, will

be a source of constant rotatory motion; and, in the present case, it will be found that the means of compressing the sponge may be best obtained by buoyancy, instead of weight.

For this purpose, therefore, the band of sponge is supposed to be divided into eight or more equal parts, 1 2 3 4, &c., each part being furnished with a float or buoyant vessel, *f* 1, *f* 2, &c., rising and falling upon spindles, *s s s*, &c., fixed in the periphery of the drum; these floats being of such dimensions that, when immersed in water, the buoyancy or pressure upwards of each shall be sufficient to compress that portion of the sponge connected with it, so as to squeeze out any water it may have absorbed. These floats are further arranged by means of levers *l l l*, &c., and plates *p p p*, &c., so that, when the float *f* No. 1 becomes immersed in the water, its buoyant pressure upwards acts not against the portion of the sponge No. 1, immediately above it, but against No. 2, next in front of it; and so, in like manner, the buoyancy of *f* No. 2 float acts on the portion of the sponge No. 3, and *f* No. 3 float upon No. 4 sponge.



Now, from this arrangement it follows, that the portion of sponge No. 4, which is about to quit the water, is pressed upon by that float, which, from acting vertically, is most efficient in squeezing the sponge dry; while that portion of the sponge No. 1, on the point of entering the water, is not

compressed at all from its corresponding float No. 8, not having yet reached the edge of the water. By these means, therefore, it will be seen that the sponge always rises in a dry state from the water on the ascending side, while it approaches the water on the descending side in an uncompressed state, and open to the full action of absorption by the capillary attraction.

The great advantage of effecting this by the buoyancy of light vessels instead of a burthen of weights, as in Fig. 2, is that, by a due arrangement of the dimensions and buoyancy of the floats immersed, the whole machine may be made to float on the surface of the water, so as to take off all friction whatever from the centre of suspension. Thus, therefore, we have a cylindrical machine revolving on a single centre without friction, and having a collection of water in the sponge on the descending side, while the sponge on the ascending side is continually dry; and if this cylinder be six feet wide, and the sponge that surrounds it one foot thick, there will be a constant moving power of thirty pounds on the descending side, without any friction to counteract it.

It has been already stated, that to perpetuate the motion of this machine, the means used to leave the sponge open on the descending side, and press it dry on the ascending side, must be such as will not derange the equilibrium of the machine when floating in water. As, therefore, in this case the effect is produced by the ascent of the buoyant floats *b*, to demonstrate the perpetuity of the motion, we must show that the ascent of the floats *f* No. 1 and *f* No. 3 will be equal in all corresponding situations on each side of the perpendicular; for the only circumstance that could derange the equilibrium on this system, would be that *f* No. 1 and *f* No. 3 should not in all such corresponding situations approach the centre of motion equally; for it is evident that in the position of the floats described in the above figure, if *f* No. 1 float did not approach the centre as much as *f* No. 3, the equilibrium would be destroyed, and the greater distance of *f* No. 1 from the centre than that of *f* No. 3 would create a resistance to the moving force caused by the accumulation of the water at *x*.

It will be found, however, that the floats *f* No. 1 and *f* No. 3 do retain equal distances from the centre in all corresponding situations, for the resistance to their approach to

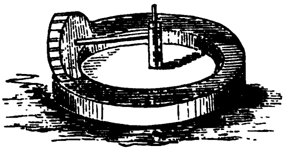
the centre by buoyancy is the elasticity of the sponge at the extremity of the respective levers; and as this elasticity is the same in all situations, while this centripetal force of the float *f* No. 1 is equal to that of the float *f* No. 3, at equal distances from the perpendicular, the floats *f* No. 1 and *f* No. 3 will, in all corresponding situations on either side of the perpendicular, be at equal distances from the centre. It is true, that the force by which these floats approach the centre of motion varies according to the obliquity of the spindles on which they work, it being greatest in the perpendicular position; but, as the obliquity of these spindles is the same at all equal distances from the perpendicular, and as the resistance of the ascent of the floats is equal in all cases, the centre of buoyancy will evidently describe a similar curve on each side of the perpendicular; and consequently the equilibrium will be preserved, so as to leave a constant moving force at x, equal to the whole accumulation of water in the sponge. Nor will this equilibrium be disturbed by any change of position in the floats not immersed in the water, since, being duly connected with the sponge by the levers and plates, they will evidently arrange themselves at equal distances from the centre, in all corresponding situations on either side.

It may be said that the equilibrium of the band of sponge may be destroyed by its partial compression; and it must be admitted that the centre of gravity of the part compressed, according to the construction above described, does approach the centre of motion nearer than the centre of gravity of the part not compressed. The whole weight of the sponge is, however, so inconsiderable, that this difference would scarcely produce any sensible effect; and if it did, a very slight alteration in the construction, by which the sponge should be compressed as much outwards as inwards, would retain the centre of gravity of the compressed part at the same distance from the centre of motion as the centre of gravity of the part not compressed.

Sir W. Congreve's Plan of Perpetual Motion (vol. 7, 1827).—The following is taken by the Editor from a small pamphlet on the subject, by the ingenious Baronet himself:—

The power of a wheel thus set in motion may either be

applied in the common mode, by machinery at the end of the axis, or the wheel itself, as in the following figure, may be



made to revolve in a circular cistern of water, of any convenient diameter, being connected by an arm from the centre of the wheel to an upright revolving shaft in the centre of the cistern, so as to be connected with machinery.

[He proceeds to enlarge on the merits of the invention, gives a scheme for propelling boats, and descants on capillary attraction when glass plates are used, and proposes the use of them with water, and of copper or platina plates with mercury, concluding:—]

My principal object in publishing this little tract is, if possible, to call the attention of men of mathematical attainments to a subject which, from the general disbelief of the possibility of the thing, such men will scarcely condescend to look at. Feeling, however, that the application of a new principle is here involved, which is not liable to the general objections urged against perpetual motion, I have bestowed the most patient attention to the subject, and must confess I cannot myself discover any fallacy in the proposition here stated.

WILLIAM CONGREVE.

March 10, 1827.

P.S.—Since writing the above, I have had a conversation with one of our most celebrated mathematicians on this subject. He contends that the weights ascending on the sloping side of an inclined plane can exert no pressure so as to produce any effect on that plane, without a corresponding loss of power and destruction of the equilibrium. He seems to forget that the very principle of this equilibrium is, that the inclined plane itself, at — degrees above the horizon, supports one half the weight, and is, of course, reacted upon to an equal extent by that weight; so that if the weight were 100 lbs., 50 lbs. of this would be absolutely disposable to the compression of any substance between itself and the plane,

such as the sponge above-mentioned, the other 50 lbs. being the only part supported by the counterpoise on the perpendicular side.

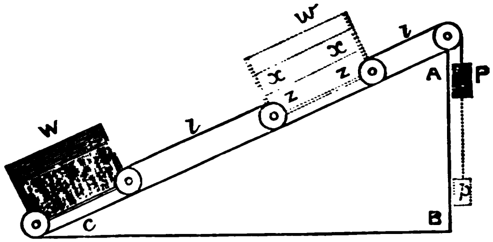
Now, will he contend that if a carpet or sponge were stretched round this inclined plane, and fixed to it so as to be allowed to absorb water on both sides by the capillary attraction, will he, I say, contend that there would not, in this case, be 50 lbs. disposable on the side A C for squeezing the water out of this sponge or carpet, by its pressure on the slope, without affecting the equilibrium, while there would be no weight pressing upon it to operate with this effect on the perpendicular side?

SIR WM. CONGREVE'S PERPETUAL MOTION (vol. 7, 1827):—

[The editor, alluding to Sir William's "Plan of Perpetual Motion from Capillary Attraction," states that the Baronet has since published a revised and enlarged edition of that pamphlet (Knight and Lacey, pp. 24, price 1s.), in which he endeavours to refute the principal objection which he has heard made to his plan by a celebrated mathematician, who opposed to Sir William Congreve's proposition a general maxim, said to exist in all mechanical operations, viz., "that no duty (to use his own terms) can be performed without a corresponding loss of efficiency." He concluded that "the weight ascending on an inclined plane can produce no positive effect, such as the compression of a spring or sponge, by which the centre of gravity of the weight shall describe a curve instead of a straight line, without an equivalent loss of efficiency." The propounder of this objection defied Sir William to produce an instance to the contrary, and agreed to leave the decision of the main question to this issue. Sir William therefore offers the following as a proof that power may be gained by his plan without any corresponding loss in point of efficiency:—]

Let A C be an inclined plane. Now, suppose a small carriage W on four wheels, at the bottom of this inclined plane,

be connected by a line *l l* over a roller, with a counterpoise P hanging perpendicularly, so that P would have just power enough to move the carriage W slowly up the plane A C;



suppose, also, that this carriage be loaded with a yielding substance, such as sponge, filling the space *s s s s*, and having a layer of some heavy substance, such as lead *x x*, laid upon the top of it, so as to be capable of gradually compressing the sponge; and, lastly, let us suppose that, things being thus arranged, the carriage moves slowly up the plane W to *w* by the action of the counterpoise; and that while this is taking place, the leaden weight *x x* has gradually compressed the sponge in the carriage into a smaller compass *z z;* in doing which, it is evident that the centre of gravity will describe a curve instead of a straight line. Now then, I will ask whether, under these circumstances, this change of position in the load of the little waggon will make the waggon and its contents weigh more at *w* than at W, so as to render the counterpoise P, in this last situation, less efficient in drawing the carriage up the plane?

To say there would be any increase of weight thus created in the carriage W, and any consequent loss of efficiency in the counterpoise, would indeed be most absurd; for, on the contrary, it is evident that if the sponge were wet, this sinking of the lead would produce a decrease of weight in the waggon, and, consequently, an increase of power in the counterpoise equivalent to the weight of water squeezed out.

My friend, therefore, must admit that I have fairly met his issue, and have shown that the sponge may actually be compressed by the sinking of the lead on the ascending side

without any increase of weight or loss of power, as he contends; and, consequently, that the load constantly accumulated by the capillary attraction on the descending side, must be a clear gain of power adequate to produce a perpetual motion, whether the application of this principle be by a series of small detached parcels, as in Fig. 3, or by a continued band of sponge and endless chain of weights, as in Fig. 1, which is, in effect, the same thing.

I do not mean to say that my friend's general objection does not hold good where only one power, such as gravity, is employed; for certainly, in that case, if the sponge were alternately to act as weight and power, the loss of any weight of water squeezed out on the ascending side would be felt on the descending side when the gravity of the sponge was called upon to act as a counterpoise. But the objection will not apply when two distinct powers, gravity and capillary attraction, are combined, as in the problem before us; for in this case, at the moment when the inefficiency of the mere gravity of the sponge is felt, its capillary attraction acts spontaneously, and restores the load of water on the descending side, which is necessary to give it due efficiency, as counterpoise, to sustain the motion.

It is evident, therefore, that in applying his general maxim to my proposition, he extends it beyond the just sphere of its applicability; and it is thus that we frequently deceive ourselves by the too great extension of general and metaphysical dogmas. It is thus, I am convinced, that the discovery of the very important problem now before us has been so long retarded, by the general persuasion of its impracticability, which has, during a period of unexampled progress in mechanical science, absolutely deterred men of mathematical acquirements from bestowing a moment's consideration upon this now dishonoured problem.

[This concludes the chief extracts. The editor goes on to say:—]

Sir William gives a more detailed representation on the same principle as the figure just inserted, for which the reader is referred to the pamphlet itself. He concludes with expressing his perfect conviction that he has proved "the existence of a very considerable moving force, being the 150th part of the whole weight to be set in motion." "A

power, the sufficiency of which to keep water in motion in a variety of ways, with a considerable excess to spare, will not (he says), be doubted, when it is remembered that many of the largest scale beams, with a ton in each scale, may be moved by much less than an ounce weight." "For my own part (he says), not being able to see any reason why the machine should not act, I confess that my faith is sufficiently strong to have induced me to take out a patent, and I am determined to use my best exertions to give mankind the benefit of this discovery, should it turn out, as I sincerely believe it will, a source of perpetual power without expense."

AMERICAN REVIEW of an Account of a New Scheme of Perpetual Motion, invented by Sir William Congreve, Bart. From the "Franklin Journal." Philadelphia, vol. 4, 1827.—In noticing this work, the reviewer makes the following introductory observations:—

Sir William Congreve is a member of the British Parliament, and claims to be a man of science, and an engineer. He is the inventor of the rockets which bear his name. He was also the contriver of a clock, which was intended to look like a perpetual motion. It kept a ball in motion, which served only to injure the going of the clock.*

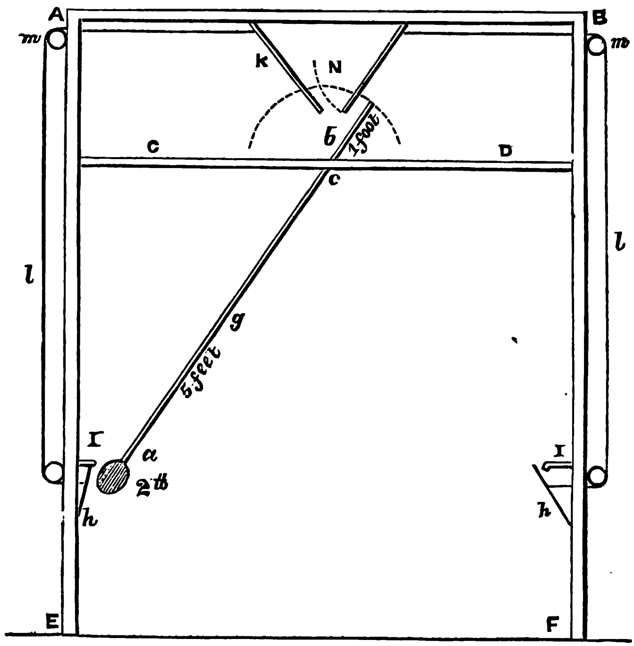
[After making extracts, which the foregoing articles anticipate, together with remarks thereon, the writer concludes:—]

The proposition of the Baronet includes the idea of a perpetual motion, as this term is restricted by those who have written upon the subject. This has been defined to be —a motion which is supplied and renewed from itself, without the intervention of any external cause. The impossibility of constructing such a machine has been repeatedly demonstrated; as to effect it would require us to discover a body which, in one position, possesses less gravitating force than in another; or, in other words, which is both heavier and lighter than itself.†

* A clock of this description is exhibited at the Museum in the Rotunda of the Arsenal, Woolwich.

† This article does not appear in the "Mechanics' Magazine."

23. A Pendulum Motion.—A correspondent (vol. 7, 1827) describes the following arrangement:—



A B E F is a frame connected by C D—a cross bar, through which runs *g*, a pendulum hung on a pivot C. This pendulum has two arms, one *a* measuring five feet, and the other *b* one foot in length, connected so together to form a lever with a long and short arm, whose fulcrum is *c*. This pendulum has a weight of two pounds at its end. K K are two short levers, having a joint in them to allow the pendulum to pass them one way, but not the other, without moving them, whose fulcra are *d d*, by which they are connected with A B. From these run cords *l l* over *m m m m* pulleys, which cords are connected (for the purpose of drawing them up into catches) with *h h*, springs throwing with a power of

three pounds. I I are catches for the springs when brought back after working their power, moving upwards. N is the point where the pendulum *g* will escape from the lever K.

There are various springs, stops, &c., necessary to keep the parts in their proper positions, which are not shown, not being essential to the consideration of the question. Now, assuming the pendulum to be brought into the position shown in the drawing, and the spring to be let loose against it, the pendulum would begin to move with a power equal to five pounds, which I assume would be sufficient to throw it up to a higher situation, on the opposite side, than that from which it set out; but in its progress its short arm comes in contact with K, to which is attached one spring *h*, which is drawn up into the catch by such motion of the pendulum. This resistance is equal to three pounds, and something more; but, because the arm of the lever to which the power is applied is five times longer than the short arm at which it meets with the resistance, it requires but at most one pound to overcome it; by which one pound of the five pounds being lost, there will remain four pounds, or two pounds above the weight at the end of the pendulum, to raise it to as high a situation as that from which it set out, and which I assume will be sufficient for such purpose. Being raised to such a situation, it will release the spring H on the opposite side, by striking up the catch; and will perform a similar motion, and be attended with similar results, as the first.

Another correspondent makes the following remarks on the proposed Pendulum Motion:—

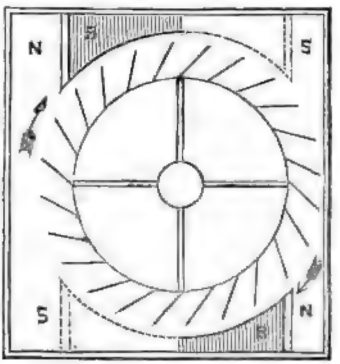
The resistance opposed by the catch I C (on the right-hand side of the plate) to any impulse, is something more than 3 lbs., this resistance being occasioned by the force of the spring, equal to 3 lbs., the weight of the catch, and its friction on its fulcrum.

The impulse is here erroneously imagined to be 4 lbs.: on the contrary, it is not quite 3 lbs. Supposing the pendulum to fall from the situation represented in the figure, it would rise to an equal height on the opposite side if all obstacles were removed. But though it starts with a momentum equal to

2 lbs., yet that is continually diminishing in consequence of friction and the resistance of the air. The end *b* coming in contact with K, something more than 1 lb. is lost, and the pendulum continues its motion until, the momentum being destroyed, it is stationary for a moment of time, and then returns. Let the point where it is stationary be called *n*, and let the pendulum again start from the situation in the figure, with the additional momentum of 3 lbs. from the spring. This 3 lbs. is undiminished until the pendulum arrives at *n;* it is then called into action, and gradually diminishes from the obvious causes above stated—friction and the resistance of the air. Hence the momentum with which the pendulum strikes the catch is something less than 3 lbs., to overcome a resistance something more than 3 lbs.

24. Perpetual Motion by Magnetism (vol. 9, 1828). —The inventor says:—

The object of the present communication is to lay before your readers an attempt at perpetual motion by means of magnetism, applied somewhat differently to any that has yet been published in your Magazine.



The above is a wheel of light construction, moving on friction wheels *in vacuo;* the rim is furnished with slips of steel,

—pieces of watch-spring will do. N N are two magnets, which, attracting the rim of the wheel, will render one side lighter and the other heavier, causing it to revolve *ad infinitum:* or, to render it more powerful, let the steel rims be magnetized, and fixed on the wheel with their north poles towards its centre. Let two more magnets be added, as shown by the dotted lines: let these two, S S, be placed with their south poles nearest the rim of the wheel; and the other two, N N, with their north poles in that position. Now, as similar poles repel and opposite poles attract, the wheel will be driven round by attraction and repulsion acting conjointly on four points of its circumference. B B are blocks of wood, to keep off the attraction of the magnets from that part of the wheel which has passed them.

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25. Cox's Perpetual Motion (vol. 10, 1828):—

As one of your correspondents mentions my having in my possession an engraving and description of the perpetual motion clock which occupied a prominent place in Cox's Museum, some fifty or sixty years ago, I beg leave to enclose the same.—I am, Sir, yours, &c., W. P.

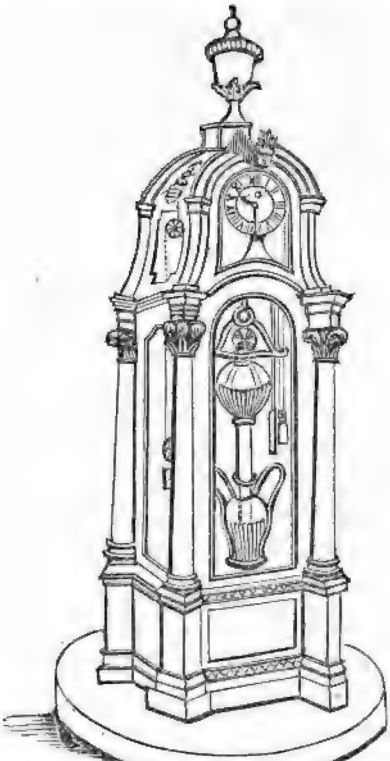
Chatteris, Cambridgeshire.

Description of the Engraving.—On the back of the engraving, we are first presented with what appears to have been an extract from a descriptive inventory of Cox's Museum, written in a very showman-like style, and conveying but little real information with respect to the construction of the piece of mechanism pretended to be described. It is in the following terms:—

"The Perpetual Motion is a mechanical and philosophical time-piece, which, after great labour, numberless trials, unwearied attention, and immense expense, is at length brought to perfection. From this piece, by an union of the mechanic and philosophic principles, a motion is obtained that will continue for ever; and although the metals of steel and brass, of which it is constructed, must in time decay (a fate to which even 'the great globe itself, yea, all that it inherit,' are exposed), still the primary cause of its motion being constant, and the friction upon every part extremely insignificant, it will continue its

action for a longer duration than any mechanical performance has ever before done.

"This extraordinary piece is something above the height, and about the dimensions, of a common eight-day pendulum



clock; the case is of mahogany, in the architectural style, with columns and pilasters, cornices and mouldings, of brass, finely wrought, richly gilt, and improved with the most elegantly adapted ornaments. It is glazed on every side; whereby its

construction, the mode of its performance, and the masterly execution of the workmanship, may be discovered by the intelligent spectator. The time-piece is affixed to the part from whence the power is derived; it goes upon diamonds; or, to speak more technically, is jewelled in every part where its friction could be lessened; nor will it require any other assistance than the common regulation necessary for any other timekeeper, to make it perform with the utmost exactness. Besides the hour and minute, there is a second hand, always in motion; and to prevent the least idea of deception, as well as to keep out the dust, the whole is enclosed within frames of glass.

"N.B.—The very existence of motion in the time-piece is originated, continued, and perfected, from the philosophical principle by which alone it acts."

Following this, there is an address "To the Public," from another pen (apparently), which seems to have been intended to throw some light on "the philosophical principle" so mysteriously spoken of by Mr. Cox; but leaves it in as much obscurity as before. The following is the only part of it that need be quoted:—

"The constant revolution of wheels, moving in vertical, horizontal, and other directions, is not only physically produced, but the indication of time from an union of the philosophic with the mechanic principles is effected. Upon the dial, besides a minute and an hour hand, is another hand, dividing the minute into sixty equal parts. These hands are motionless till affixed to the primary motion; so that the motion of the time-piece (as Mr. Cox expresses it) is originated, continued, and perfected, by the philosophic principle through which it is solely actuated."

The secret is, however, at last divulged, in the subjoined certificate from the celebrated philosopher, James Ferguson:—

"I have seen and examined the above-described clock, which is kept constantly going by the rising and falling of the quicksilver in a most extraordinary barometer; and there is no danger of its ever failing to go; for there is always such a quantity of moving power accumulated, as would keep the clock going for a year, even if the barometer should be taken quite away from it. And indeed, on examining the whole contrivance and construction, I must with truth say that it is the most ingenious piece of mechanism I ever saw in my life.—James Ferguson, Bolt-court, Fleet-street, Jan. 28, 1774."

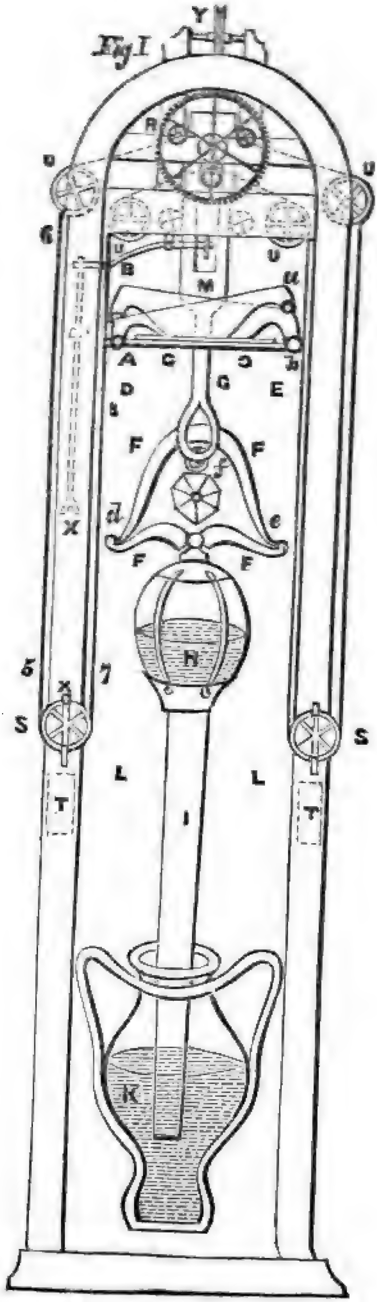


Fig. I

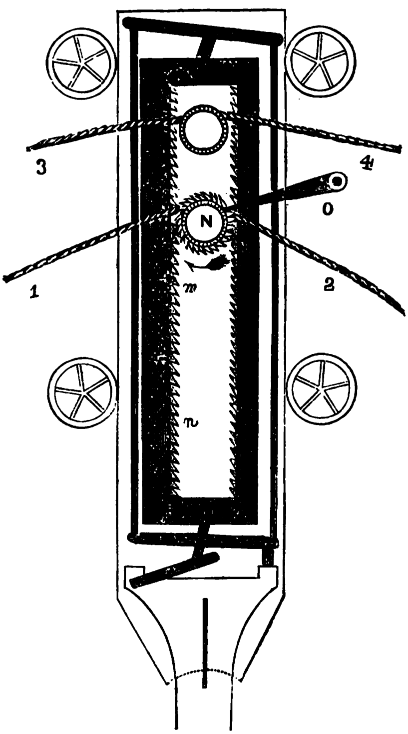
Cox's Perpetual Motion (vol. 11, 1829).—The following is given as a description of the internal mechanism of the perpetual motion clock; collected "from a very large engraving," inscribed "'to the King's most Excellent Majesty,' by Mr. James Cox; and a letter-press description written by the philosopher, James Ferguson, published some years since (but without a date):"—

This clock was kept in constant motion by the rise and fall of a considerable weight of quicksilver. The manner in which this motion was made subservient to the purpose of dividing time will, I hope, be rendered intelligible by reference to the accompanying drawings.

Fig. 1 is a front view of the machine. A *a* and B *b* are two strong pieces of metal, curved on the under side, like the foot of a rocking cradle, to which their motion on the supporting plate C C is similar; they are therefore distinguished by the name of cradles. To the end of the cradle A is hung a rod D *d*, and to the opposite end of the other cradle *b* is hung the other rod E *e*. By the lower end of these two rods (which are of equal length), at *d* and *e*, the frame F F F F hangs, with the gimbol *f* and its upright bar G. To the middle of the lower part of this frame is hung the large glass ball or bulb of a barometer H; the tube of which, I, goes down into the quicksilver in the glass cistern K. This cistern is supported by two rods L L, whose ends hang from the contrary ends of the cradles A *a* and B *b*; the right-hand rod from the end *a* of the cradle A *a*, and the left-hand rod from the end B of the cradle B *b*. A very small degree of attention to this connexion will show that if the bulb H be pulled down it must draw up the cistern K, and if the cistern be pulled down it will draw up the bulb; for, as either end of the cradle goes down, the other end must rise. The cistern being open at top, the atmosphere exerts a varying pressure on the surface of the quicksilver; and when heavy, forces the greater part of it up the tube I into the bulb H: this makes the bulb heavy and the cistern light; the bulb, therefore, descends, and draws up the cistern. On the contrary, when the air becomes light, its pressure is so much the less on the surface of the quicksilver in the cistern; and being then unable to support the lengthened column of quicksilver in the bulb, part of it descends into the

cistern, which, becoming thus heavier than the bulb, descends and draws it up. And thus, when the air is heavy the bulb descends, and ascends when the air is light, through more than double the space that the mercury rises and falls in a common barometer. The frame F F F F and its upright G being con-

(*Fig.* 2.)



nected with the bulb, rise and fall with it. To this upright bar G is attached the wind-up frame M,—which is shown on a larger scale in Fig. 2. In this frame are two thin metal plates

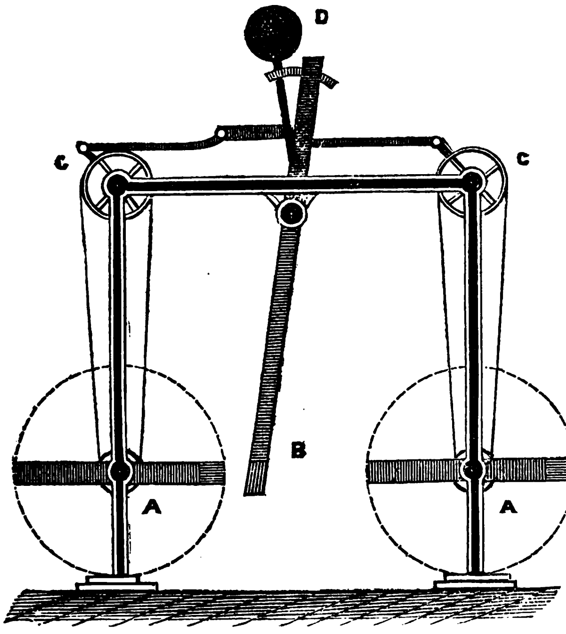
m and *n*, toothed like the blades of saws, one set of teeth *m* pointing downwards, and the other set *n* pointing upwards. When the frame falls, the teeth of the saw *m*, by means of a sliding movement, engage the teeth of the wheel N, and turn it round in the direction shown by the arrow; when the frame rises, the saw *m* is disengaged by the sliding movement, and the saw *n* is brought into connexion with the wheel N, which it turns round in the same direction as before; so that whether the frame ascends or descends, it is continually turning the wheel N in the same direction. This frame moves between four friction wheels, which retain it in an upright position. O is a catch which falls into the teeth of the wheel, to keep it from being turned in the contrary direction, by any accident, during the short intervals of time between one of the saws leaving the wheel and the other taking into it. On the back of the wheel N is a pulley, with sharp-pointed pins fixed in the bottom of its groove, for laying hold of the endless chain 1, 2. Above this is just such another pulley, over which the chain also goes, 3, 4. This last pulley is fixed on the axis to the great wheel (R, Fig. 1) of the clock movement, by which the whole of the clock-work is put in motion.

Returning to Fig. 1:—The endless chain just described passes over the four upper pulleys U U U U, which are fixed, and under the two lower ones S and S, which rise and fall with the heavy weight T on one side, and the lighter counterpoise *t* on the other side, which hang from the pulley frames. The weights consisted of two boxes made of thin brass plate; but T was filled with lead, while *t* was quite empty The weight T acts with half its force of gravity upon the part 5, 6, of the endless chain, and with the other half upon the part 7, 8. By pulling the former part, it turns round the great wheel R as fast as the motion of the balance of the clock will permit that wheel to move. It will be seen that if this motion continued for a short time, the weight T would go down to the bottom, and then the clock would stop. But the train of the movement is such, that the weight would keep the clock going a whole year, before it would descend quite to the bottom of the machine. By the above-mentioned contrivance of the wind-up frame M, which, as it moves up and down, turns the wheel N round (in a direction contrary to that in which the pulley and wheel R is moving), and draws up the chain in the direc-

tion 7, 8, while the weight T is pulling down the part 5, 6, the weight is prevented from ever going down to the bottom, and a perpetual motion is produced in the clock, by the alternating pressure of the atmosphere on the barometer H I K. The weight of quicksilver employed was about one hundred and fifty pounds.

The only inconvenience that Mr. Cox found in all this machinery was, that the changes of the air affected the barometer so much as to draw up the weight through more space than the clock movement would allow it to descend; which tended to overwind the clock and break the chain. To remedy this, Mr. Cox made the wind-up wheel to turn loose on the arbor, whenever a click was discharged from its ratchet wheel. And although the action of the wind-up frame, &c., would continue, they would have no effect upon the chain pulley and arbor, which would remain at rest till such time as the weight T had again descended, and permitted the click to regain its hold of the ratchet wheel. I may observe, that the discharge of the click, in the first place, was effected by the rising of the weight T; for when the top x of the pulley frame S reached the rod X, it raised it, and, by means of the levers, disengaged the click. To counterbalance the weight of the wind-up frame M, one end of a short chain is fixed to the back of it; and after the chain is put over the pulley Y, at the top of the machine, a weight is hung on the end of the chain. It may be observed that as the weight T has four feet to descend from the top to the bottom, its power upon the time-piece must be as much lighter when at top, or heavier when at bottom, as double the difference of the weight of so much chain; which would cause an irregularity in the going of the clock, as it has a balance and not a long pendulum. To avoid this inconvenience, the weight T was made to wind up a smaller weight every twelve hours, by means of a remontoir; and this smaller weight acting upon the time-piece, kept it in motion. As it is the perpetual motion part which I wished to explain, I have omitted the clock movements, which are of the common description—the balance spoken of consisting of a lever, supported by an axis in its centre, and loaded at each end with a weight. —W. B.

26. PERPETUAL MOTION BY MAGNETISM (vol. 10, 1828).—Alluding to a former scheme of his for applying magnetism, the inventor submits the following :—



Let A A, in the prefixed engraving, represent two magnets revolving on axes. Let B represent a larger magnet, hanging on an axis, pendulum fashion, between the two former. As the poles of the two smaller magnets lie in the same direction, the effect will be to draw the larger magnet towards that on the left hand, while it is at the same time repelled by that on the right; but while this is going on, the upper end of the large magnet raises, by means of a guide wire, the tumbler D, which, just before the magnets come in contact, passes the perpendicular, and falls over, carrying with it the lever connected with the two wheels C C, and causing them to perform a quarter revolution; these wheels are connected by lines with two small

wheels fixed on the axles of the two magnets A A. While the former make a quarter revolution, the latter turn half round; consequently, the position of the magnets is reversed, and the same motions are then performed by the pendulum magnet being attracted and repelled in the opposite direction; and just before the magnets touch each other, the arrangement is again instantly reversed.

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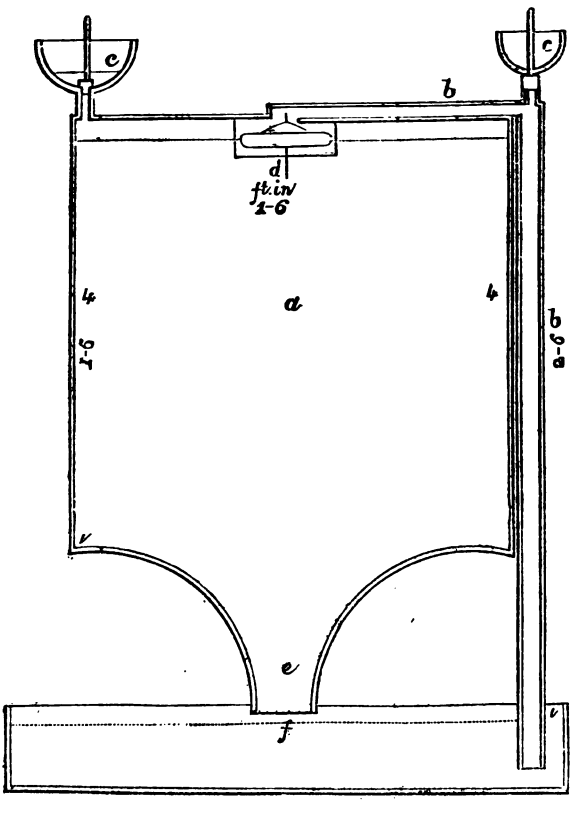
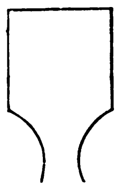
27. A PERPETUALLY-FLOWING SYPHON (vol. 10, 1828) is described by reference to the annexed sectional figure:—

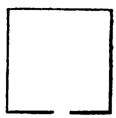


a is a circular glass vessel, 1 foot 6 inches diameter; *b b*, a tube fixed thereunto: *c c* are funnels containing valves; *d*, a float of hollow copper, or any light substance; *e*, an open mouth; *f*, an open vessel filled with mercury as high as the dotted line.

It is well known that several experiments were made by M. Venturi, Sir Isaac Newton, &c., demonstrating that a vessel shaped thus—



will emit water with a much greater rapidity than a vessel shaped thus—



say, with more than a third as much more speed. I propose, then, to have the mouth of the vessel *a* of the former shape, being the natural form of flowing water. The vessel *a*, and tube *b*, must be completely filled with mercury, by means of the funnels *c c*, which will also contain mercury. In order to set the fluid in motion, the valve in the large vessel *c* is to be raised; the mercury (which was hitherto held up by a greater weight of atmosphere) will instantly run out of the mouth *e*, and must be suffered to do so till the mercury in *c* is level with the dotted line: by this time the mercury in *a* will have obtained a momentum * which will be more than equivalent

* "Water not only gravitates with the vessel that contains it, but independently of it; and thus, if the containing vessel is supposed stationary, and a hole is bored in its bottom, the contained water will flow out and descend through the air for the purpose of obtaining a lower situation than it before occupied; and in so flowing out, those particles of fluid which were over, or in immediate contact with, the hole, will be discharged first," &c.—"Library of Useful Knowledge."

to the pressure of the atmosphere; consequently, the mercury will run out of the large vessel *a*, till it falls as low as the dotted line; the float *d*, resting on the mercury, of course falls with it, opens the valve, and admits a proportionable quantity of mercury through the tube *b*, driven by the pressure of the atmosphere (the height from the mercury in *f*, to the top of the tube *b*, being only 26 inches; which is 2 inches less than what the atmosphere will at all times raise mercury in a vacuum).

By this means will there not be a continual circulation of mercury?

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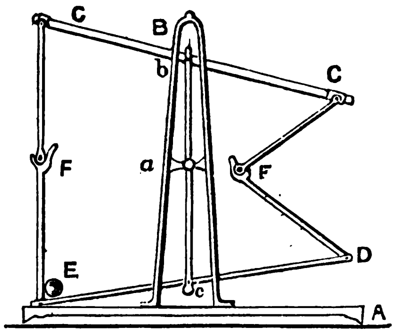
28. NEW MECHANICAL MOTION (vol. 11, 1829).—A correspondent says:—

To the curious who delight in mechanical intricacies, to whom ingenuity of contrivance is the goal for which they run, nothing seems to afford and require such endless resources as that most puzzling thing—perpetual motion. The unfortunate name "perpetual motion," if changed for "mechanical experiment," would eventually, perhaps, remove the real cause of censuring it, by the different idea of the object aimed at.



I now beg leave to offer some account of a combination of movements, which, from its originality, and seeming to

possess every requisite for retaining it in action, may possibly be acceptable.

This diagram shows a side view. On the stand A are raised two supports B, each having a centre hole at *a*, to receive the axle of the balanced apparatus, consisting of C, a glass tube containing a portion of mercury G; and D, a grooved scaleboard, in which a ball, E, can roll backwards and forwards. F F are two jointed levers, which are to serve, when struck by the ball, to reverse the position of the compound balance: the whole centred at *a*, the tube at *b*, and the grooved board at *c*. In its present position, the mercury (it is supposed), having flowed to the end C, will depress D, and cause the ball E to roll to D, and depress the end G F D; and so on continually.

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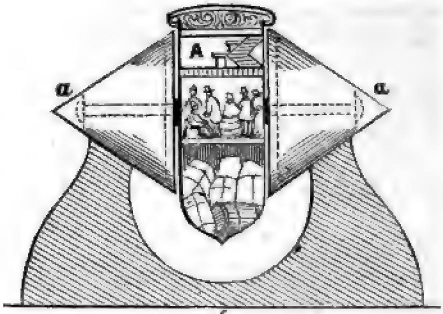
29. Self-moving Railway Carriage (vol. 12, 1829). —A correspondent writes:—

In treating of perpetual motion—"that grand secret for the discovery of which those dictators of philosophy, Democritus, Pythagoras, Plato, did travel unto the Gymnosophists and Indian priests"—it would add considerable interest to give some account of its early history. Regarding the fallibility of every contrivance hitherto planned or experimented upon, we may gather sufficient from the writings of Bishop Wilkins alone. The "little world" of Paracelsus and his followers—the planetarium invented by Cornelius Dreble, for King James—the "magnetical globe or Terella," suggested by Pet. Peregrinus, with the wheel that he, Taisner, and Cardan thought might be kept in motion by "pieces of steel and loadstones"—are, like the Bishop's own wheel and plummets, and his application of Archimedes' screw, inadequate to the grand end for which they were designed.

Without enlarging on this head, we shall proceed with the description of a machine which, were it possible to make its parts hold together unimpaired by rotation or the ravages of time, and to give it a path encircling the earth, would assuredly continue to roll along in one undeviating course till time shall be no more.

A series of inclined planes are to be erected in such a manner that a cone will ascend one (its sides forming an acute

angle), and, being raised to the summit, descend on the next (having parallel sides), at the foot of which it must rise on a third and fall on a fourth, and so continue to do alternately throughout.



The diagram is the section of a carriage A, with broad conical wheels *a a*, resting on the inclined plane *b*. The entrance to the carriage is from above, and there are ample accommodations for goods and passengers. The most singular property of this contrivance is, that its speed increases the more it is laden; and when checked on any part of the road, it will, when the cause of stoppage is removed, proceed on its journey by mere power of gravity. Its path may be a circular road formed of the inclined planes. But to avoid a circuitous route, a double road ought to be made. The carriage not having a retrograde motion on the inclined planes, a road to set out upon, and another to return by, are indispensable.

I am indebted to a much-respected friend for the hint of this means of effecting a veritable perpetual motion.

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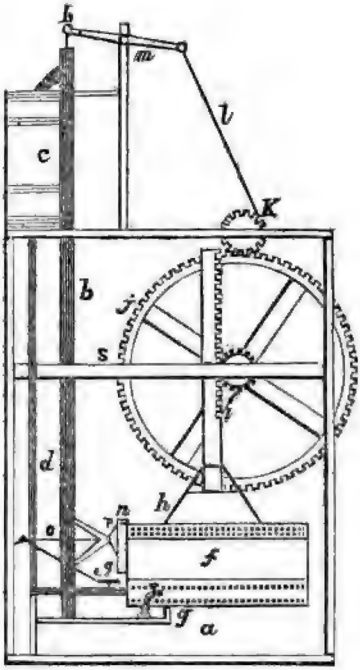
30. An Exercise for Perpetual Motion Seekers (vol. 13, 1830).—The inventor says:—

Let us suppose an apparatus to be constructed of the description represented in the annexed engraving: *a* is a

water cistern, whence water is to be raised by the pump *b*, to supply the cistern; *c d* is a small pipe with a stop-cock at *e*, which lets the water from cistern *c* into a strong water-tight bellows *f*. The bellows have no valve, but a cock *g* to let out the water into cistern *a*; *h* is a weight, and *i* a rack on the top of the bellows which works in the cogs on the axle of the large cog-wheel *j*; *j* turns the little cog-wheel *k*, that gives motion to the arm *l*, and works the pump-handle *m*;



n is an upright rod on the end of the lever *o*, which rod has a turn at *p* and *q* for the top of the bellows to press against in ascending and descending. The water being let into the bellows from the pipe *d*, will cause the top of the bellows,

with the weight and rack, to ascend till the former reaches and presses *p*, which will move the lever *o* and the arm or rod *r*; by which means the stop-cock *e* of the pipe will be shut, and the cock *g* opened, and the water let in from the bellows into the cistern *a*. The top of the bellows will now descend till it comes down and presses the turn *q*, which will again shut the cock *g* and open *e*, on which the water will again flow from the pipe into the bellows, and cause the top with the rack to ascend.

Now it is generally known that the power of an hydrostatic bellows is thus calculated:—

As the area of the orifice or section of the pipe,
To the area of the bellows:
The weight of water in the pipe is,
To the weight the bellows will sustain on the top-board.

We will suppose, therefore, the pipe *d* to be 10 feet high, with a bore equal to 1 square inch, which would give 120 cubic inches, and about 4¼ lbs. of water. Let us suppose, also, the boards of the bellows to be 20 inches square, which gives 400 square inches. When the water is let from the pipe into the bellows, there will be a pressure of 4¼ lbs. on every square inch, which on the whole will amount to 1700 lbs. Now take half of this force and place it on the top of the bellows; there will then be a working power of 850 lbs. up and down, and allowing the bellows to raise one foot, it will contain about 20 gallons of water. Now the question is, will not the machinery, with a moving power of 2 feet and 850 lbs., raise 20 gallons of water 10 feet, which would, of course. cause the motion to be perpetual?—John Sims.

Pwllheli, North Wales, Dec. 11, 1829.

Remarks on foregoing Scheme (vol. 13, 1830).—A correspondent says:—

Had Mr. Sims gained the power exerted by the descending weight on his bellows, he would have been fortunate indeed; but it unfortunately happens that its returning power (or an equivalent) was expended in raising it.

With respect to his question, whether a circulation of water would be kept up by the arrangement, I answer, no;

as the velocities will be in the inverse ratios to the forces, and the descending column of 120 inches must expend itself forty times to raise the ascending one to the height of twelve inches, as proposed :—

10 ft. or 120 in. × by 40 = 4800, lifting force or power.
400 in. × 12 = 4800, opposing force, resistance, or weight.

Here is an equilibrium, and nothing gained to overcome friction or the weight of the atmosphere on the piston of the pump. Were it possible to annihilate both friction and atmospheric weight, even then, unless the power exceed the weight, the power would not be a moving one.

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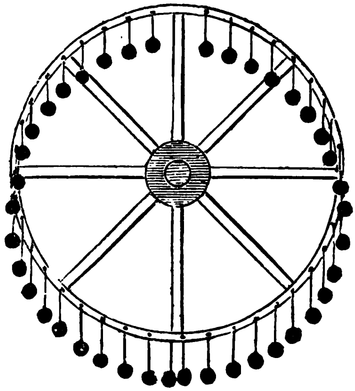
31. The Marquis of Worcester's Scheme of Perpetual Motion (vol. 13, 1830).—A correspondent, alluding to the construction of the Marquis of Worcester's invention, No. 56, says :—

The pretensions of the Marquis in his description of this wonderful piece of ingenuity may be very simply effected; that is, they may fall out to the distance of 1 foot in passing the vertex of a wheel of 7 feet radius, or, as he has it, 14 feet over; and, on the contrary, they would fall in passing the vertical diameter at the bottom, or, as he has it, on the lower side move a foot nearer. I shall give what I consider to come as near to the Marquis's plan as the words of his description can suggest to one who has travelled much farther than him in this mazy road. I have no doubt but the following drawing exhibits the principle of the Marquis's wheel. It will be observed that he particularly mentions the weights shifting their position in passing the diameter line of the upper and lower sides, meaning, as I have taken it, the vertical diameter (though the shifting may be made to take place in any part of the circumference on the opposite sides); but this circumstance most probably induced him to overlook that, though the horizontal distance was greater in the upper descending quadrant than in the lower ascending one, or opposite end of the respective diameters, still the reverse takes place in the remaining half of the wheel, and when

each weight has taken its new position at the shifting point, equilibrium is preserved.

I beg leave to add that it is not by such crude notions as this, or any other I have seen published as expositions in support of the prejudices entertained against this subject, that the question can be decided; I believe there are principles, could they be brought into action, which would effect the desired purpose, and the difficulty is mostly in the practical application.



Explanation of the Engraving.—The diameter of the Marquis's wheel is 14 feet, and its circumference 44, very nearly, which, divided into 40 portions of 1 foot each, for the weights to move in, leaves 4 feet, or 48 inches, for the intervals of space to stay the weights, and allows of iron pins of about $1\frac{1}{5}$ in. in diameter, as represented; the rest of the figure needs little explanation. The mode of attaching the weights may vary; but as the Marquis's words are, "they hung," I have represented them as so doing in the grooves of the wheel on a pulley, running on the two rims of iron composing the circumference thereof; and if the weights are divided in two parts, one half being on each side the wheel, the lateral pressure thereon will be prevented. The only motion that would take place on this plan would be a vibra-

tion to the extent of about 10 degrees of a circle, on the wheel being slightly agitated either by design or accident, unless a moving force were applied in either direction sufficient to cause it to revolve on its axis. It is probable the Marquis designed that the space the weights moved through should be chords of the arc, or a direct line, and not portions of the circumference; still this alters not the case.

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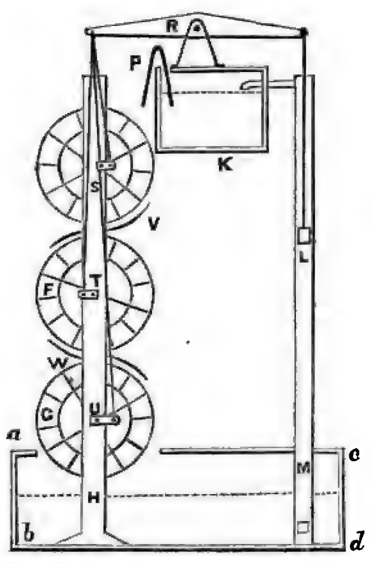
32. Perpetual Water-wheels and Pumps (vol. 14, 1831).—A correspondent gives a description of a plan which he says he believes to be entirely original, and not without considerable claims to plausibility, thus:—



Let *a b c d* represent a wooden cistern, or trough, half filled with water; E F G, three overshot water-wheels, supported by the upright piece; H K is another cistern, or

trough, filled with water up to the dotted lines; P is a syphon to convey water from the lower to the upper cistern K; R is a beam supported from the cistern; S T U are moveable cranks attached to the horizontal shafts through the centre of the water-wheels,—each crank has a connecting-rod to the beam R; V W are two curved spouts to convey water from one wheel to another. It may be well here to premise that each water-wheel has a pump and beam, as only one is seen in the section.

Now, in order to put the machine in motion, it is only necessary to draw a portion of water from the syphon over the wheel E, which immediately revolves, consequently the pump L M draws water from the lower to the upper cistern K. Now, the water passing over the wheel E, is collected by means of the curved spout V, and is conveyed upon the middle wheel F, which also gives motion to another pump, and draws water in like manner. Again, the water passing over the middle wheel, is collected as before by another curved spout W; consequently, the lower wheel is put in action, accompanied with another pump. Hence it is obvious that three water-wheels and three pumps are worked by one stream of water from the syphon. What more is required to perpetuate its motion?

JOHN LINLEY.

Wicker Sheffield, May 28, 1830.

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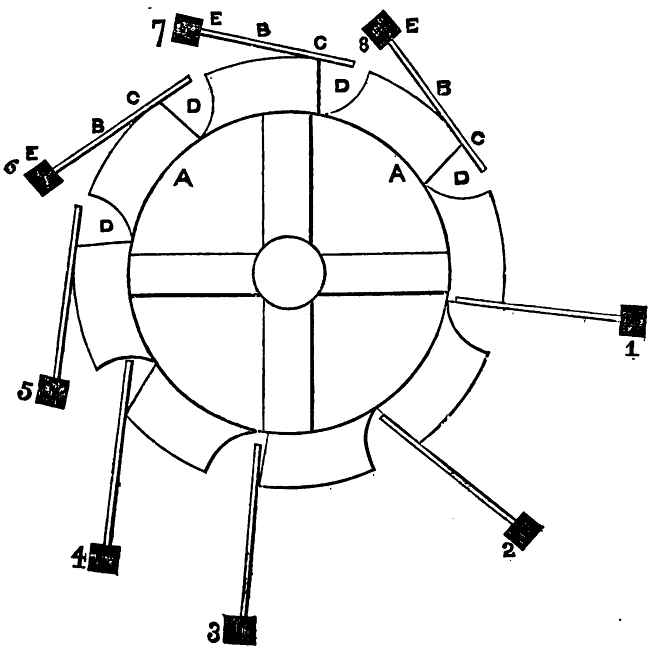
33. WHEEL AND WEIGHTS.—A correspondent (vol. 14, 1831) writes:—

The description of the design for a perpetual motion invented by the Marquis of Worcester, described in one of the recent numbers of your Magazine, has recalled to my mind an attempt of a similar kind which occurred to me some time ago, and which I have had by me ever since. It may cause some amusement amongst your readers, and may call forth the exertion of some ingenuity to discover the mistake under which I am labouring in supposing it to be perpetual.

DESCRIPTION.—A A A is a ring of thin wood; B B B, several spokes, moveable round the fixed points C C C, and only allowed to move one way by the construction of the openings D D D; E E E, heavy weights fixed to the ends of the spokes.

From the position in which the wheel is at present, it is evident that the weights on the right-hand side (1 and 2) acting at a greater distance from the centre than those



(4 and 5) on the other side, will cause that side to descend until the spoke 1 reaches the position 3, when it will exert no moving influence, but by which time the weight 8 will have fallen into the position 1, when a similar effect will take place, and so on with the rest.

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34. Self-acting Pump.

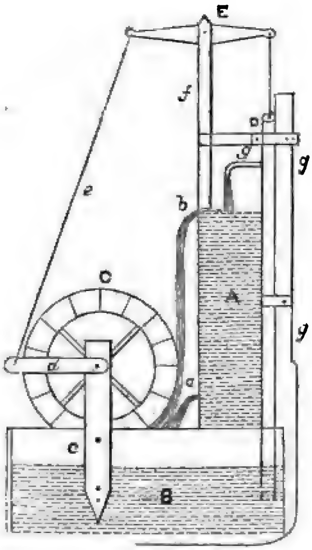
Observing that persons no less distinguished than Bishop Wilkins, the Marquis of Worcester, &c., have amused them-

selves with such things as perpetual motion, it may be some apology for a humble individual residing as I do in a very retired part of the country—scarcely within reach of much society—to confess that, by way of a little rational amusement and relief to the mind, I have at times, amid a variety of other investigations and inventions, amused myself, amongst the rest, with this of perpetual motion. The result I will, with your permission, lay before your readers. That I trespass upon your pages, you are indebted to your correspondent, Mr. Linley, whose invention, p. 104, vol. 14, I thought might partially lead to an anticipation of one of my own, a model of which I constructed a short time ago. The system which first came to my mind, as likely to lead to the accomplishment of perpetual motion, was that of the syphon; experimenting with which, opened discoveries that might prove useful in hydrostatics. Amongst these was a mode of equalizing the horizontal surface of the water in two separate vessels of different altitudes. The following sketch will afford an idea of my invention.

Let A be a vessel, having two orifices, one at the bottom of it, *a*, and the other open at the top for waste water, *b*, filled to the brim. B, a reservoir, so far filled with water as not to come in contact with the bottom of the great wheel C, whose axle turns in the wood *c*, attached to the side of the reservoir; *d*, a crank fixed to the axle of the great water-wheel, which turning moves up and down the rod *e*, attached to the beam E, which works the pump D, having its cylinder inserted in the reservoir B; *f*, an upright attached to the upper vessel A, to form a support for the beam E; the whole, together with the cylinder of the pump, being supported and tied together by the wood-work *g g g*.

To produce the motion, draw the plug from the orifice *a*, from which the water gushing out with considerable force will immediately turn the water-wheel, which communicating motion, by the crank *d* and rod *e*, to the beam E, will cause the pump D to be worked, the water from the spout passing into the upper vessel A. Now, the cylinder of the pump, if one only be used, must be of suitable dimensions, or the velocity of its movement so increased by means of a multiplying-wheel as to enable it to discharge water into the the upper vessel A faster than the same escapes through the lower orifice *a*; consequently, the vessel A will soon overflow from

the capacious opening at *b*, to which a trough is attached, which collecting the waste water, causes it to descend also upon the circumference of the water-wheel; thus contributing to its movement, and at the same time tending to preserve an uniform supply of water in the reservoir for the continued action of the pump. Hence you have a perpetual motion, so long as the whole keeps in repair and in good order, which is all that can be expected of any perpetual motion, constructed as it must be of perishable materials.



But of what use are all the perpetual motion machines, if they can perform no other work than that of keeping themselves in motion? For it is evident, in the case of my machine, that if I wish to increase the power of the wheel, fixed as it is in size, radius, &c., I must increase the jet of water, and consequently the pumps must be made of corresponding dimensions, or exert a corresponding increase of

force or velocity to replace the water; so that it is evident, neither Mr. Linley's machine nor mine, in their present fixed state, can perform more than the simple operation of pumping their own water.

And this is the case with all the perpetual motion machines I have ever observed—they can exert no useful or disposable power beyond that of keeping up an equilibrium, or getting beyond the point of equilibrium. * *

Yours, &c.,
AUTHOR OF THE "VOICE OF REASON."

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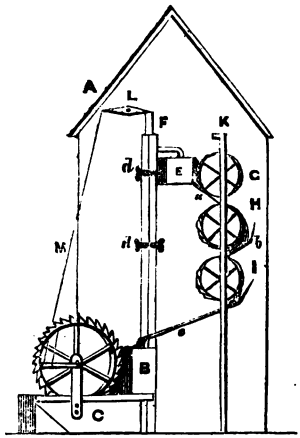
35. PERPETUAL WATER MILL (vol. 14, 1831).—The inventor says:—

I propose to endeavour to show how my plan of perpetual motion could be applied to practical and useful purposes. With a view to this, I give the prefixed sketch, with the following description of its construction and use:—Let A represent the side-wall or gable-end of a house, from 40 to 50 feet in elevation; B, a cistern, filled with water, having an orifice near its bottom, and another open at the top, for the ready escape of waste water, as before; C, a reservoir, so far filled with water as not to come in contact with the bottom of the water-wheel D, which, being an undershot wheel, may, of course, be of such radius as is suitable for the power required to raise the water. Let E be another cistern, filled with water, equal to and provided with orifices as in cistern B, both orifices together discharging water faster than it escapes from the lower orifice of the cistern B; F, two (or more, as the case may require) pumps, or expressing-fountains, supported against the wall by ties *d d*, and having their cylinders inserted in the reservoir C, and their lower suckers fixed at a little less than 32 feet above the surface of the fluid in the reservoir C. These expressing-fountains discharging their water into the cistern E a trifle faster than it escapes from its lower orifice, at an elevation of at least 33 or 34 feet above the surface of the water in the reservoir C, will afford space for water-wheels, supported against the wall by the upright K, say three water-wheels, G H I, of at least eight feet in diameter each, or two only of greater diameter. The upper wheel G being an undershot one, if not of greater radius

than four feet, which it might be, may have its axle fixed at an altitude of at least 30 feet, and allowing the space of a foot between each water-wheel for the troughs *a* and *b*, which collect and convey the water from wheel to wheel, will give a space of 22 feet, occupied by the three water-wheels, leaving 10 feet for the descent of the water by the trough *c* to the cistern B (which may be four or five feet in depth), and thence to the reservoir C, which may be three or four feet in depth; also the cistern E may be four or five feet in depth, and all of other corresponding dimensions *ad libitum.* To



produce the motion, remove the plugs or stoppers from the lower orifices of the cisterns E and B; the water rushing from the latter turns the great water-wheel D, which works the expressing-fountains into the upper cistern E; from the orifices of which, the water escaping turns the undershot wheel G (which may be of larger diameter, if required); whence being collected by the spout *a*, it shoots over and turns the wheel H; being collected by the spout *b*, it turns the overshot wheel I; whence being collected by the spout *c*, it is conveyed into the cistern B, from thence to the water-

wheel D, and, finally, into the reservoir C, from which it is raised again by the fountains into the upper cistern E; and so on as long as you please, or as long as the whole keeps in repair and in good order. The apparatus may with facility be stopped for convenience at any time without fear of derangement, because the fountains carrying water faster than it escapes from the lower orifices, the cisterns will be always full; and it may be again set in motion with equal facility. With the above proviso, it cannot stop till the prevailing natural causes which gave it motion—viz., the pressure of the atmosphere and the descent of water, which in their nature and tendency are of themselves perpetual—shall be diverted. Thus you may have the power, free and disposable, of three water-wheels in perpetual motion, to be applied to such useful purposes of machinery within the building as its inmates may require. A supply of water-mills might be thus provided in any situation—in the centre of the metropolis or other large towns—in places subject to a deficiency of rivulets suitable for mills on the common system. Neither would there be any necessity for resorting to rivers, or raising immense buildings upon their banks; wherever there was a convenient house, it might be readily appropriated with little further expense than machinery.

Yours, &c.,

Jan. 10, 1831. ED. "VOCIS RATIONIS."

A FEW REASONABLE CONSIDERATIONS addressed to the Author of the "Voice of Reason" (vol. 15, 1831).—Two correspondents offer the following remarks on the preceding plans. The first says;—

I have considered with attention the plan for a perpetual motion, invented by the author of the "Voice of Reason."

In the plan laid down by your correspondent, it requires one entire revolution of the water-wheel to produce a single stroke of the piston; and, by the same rule, the water expressed by one operation of the piston must furnish the

impulse for an entire revolution of the wheel. The pistonic operations might, indeed, be multiplied by the introduction of a pinion revolving to the water-wheel in the proportion of 2 or 3 to 1; but just in proportion to the number of revolutions made by the pinion, there must be an increased expenditure of momentum on the water-wheel,—it being an invariable law in mechanics, that what is gained in time is lost in power; therefore, there would be nothing, in reality, either gained or lost by this manœuvre.

We will suppose the barrel of the pump to be six inches in diameter, and that every stroke of the piston will produce a cylindrical column of water two feet in length. I put it to the good sense of your correspondent, whether it be possible to employ this inconsiderable force in such a manner as to cause a wheel of such magnitude to revolve with all its appurtenances, and a weight of water attached to it sixteen times heavier than the impulse.

If it be answered that a constant stream will be accomplished by the small aperture at the bottom of the cistern, I reply, this does not meet the objection; for a constant supply is only a succession of parts which do not push each other; and whether a portion of the water be suffered to gush out of an aperture at the bottom, or the whole be allowed to fall over the tumbling bay at the top of the cistern, no real advantage will be obtained, for no more than a two-feet column of water can be brought into action till the wheel has completed its revolution.

The wheel and crank being a lever of the first class, in order to balance a weight equal to 32 (the column of water in the pump) by a pressure equal to 2 (the water drawn by a stroke of the piston), the arms of the lever must be in the proportion of 16 to 1; now, to accomplish a two-feet plunge into the barrel of the pump, the crank, or short arm of the lever, must be one foot from the fulcrum, or axis of the wheel,—consequently, the radius of the wheel must be 16 feet (exactly the height of the pump); and then what becomes of the intermediate machinery of the three water-wheels, &c.?

If the radius of the wheel be increased, it must be raised higher; and I ask again, how can so feeble an impulse be employed to give an entire revolution to such a ponderous body resting on its axle? * * * *

The second gives the following demonstration of the impossibility of a Perpetual Water-wheel:—

"From this example you may see how desirous people are to reach their object in their own way—what need there often is of enforcing on them truths which are self-evident—and how difficult it may be to reduce the man who aims at effecting something, to admit the primary conditions under which alone enterprise is possible."—GOETHE.

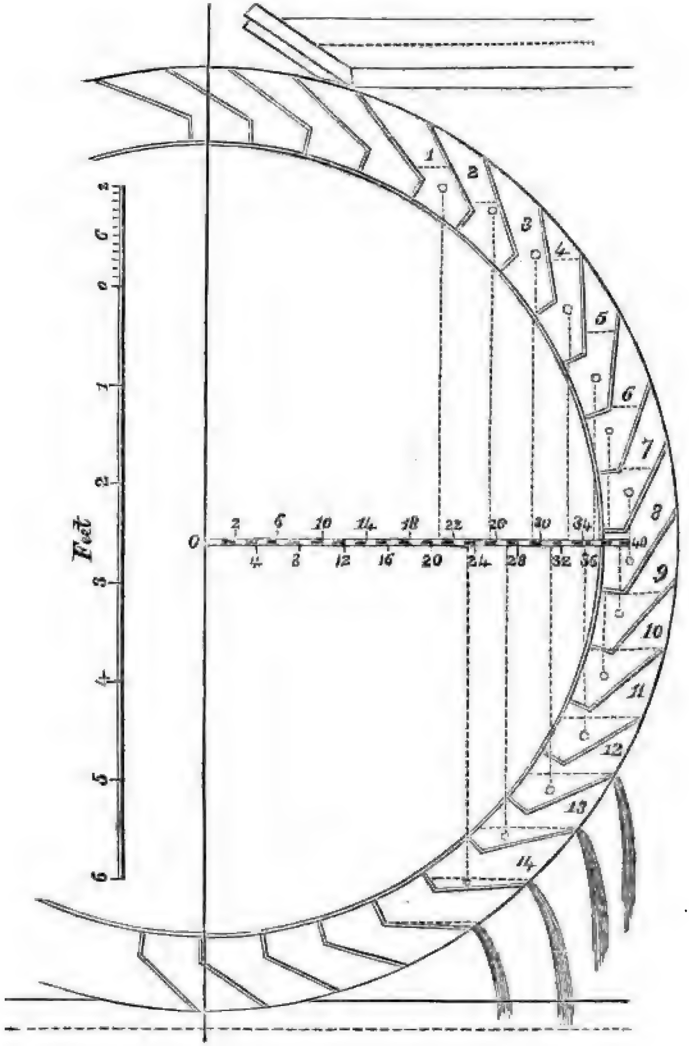
I am induced to make an attempt to demonstrate the utter impossibility, under any circumstances, of making a water-wheel that will supply itself instead of having any surplus power.

The accompanying drawing represents part of an overshot wheel in section, the buckets only part filled, by which the whole of the water expended continues to act through a greater portion of the circumference than it otherwise would do. The area of the vertical section of the complement of water to each bucket is made 40 inches; and taking the breadth of the wheel at, say $28\frac{2}{3}$ inches, gives 40 lbs. as the weight of water in each bucket; therefore, as there are 12 buckets containing 40 lbs. each, No. 13 30 lbs., and No. 14 only 20 lbs., altogether making a total of 530 lbs. acting on the wheel at the same time;—to show clearly all the effect that can be expected from this, I have divided the horizontal radius into a scale of 40 equal parts (there being 40 lbs. in each bucket); and from the gravitating centre of the fluid contained in each is drawn a perpendicular to the scale, where the effective force, or weight in each bucket, may be read off as on the arm of a common steelyard. The weights will be found as follows, viz.:—

No.	lbs.		No.	lbs.
1	$21\frac{1}{2}$	..	8	40
2	$26\frac{1}{4}$	..	9	$39\frac{1}{2}$
3	$30\frac{1}{2}$	..	10	38
4	$33\frac{3}{4}$	..	11	$35\frac{3}{4}$
5	$36\frac{3}{4}$	..	12	$32\frac{1}{2}$
6	$38\frac{3}{4}$	..	13	21 } *
7	$39\frac{3}{4}$	..	14	12 }

It is therefore quite evident that, although we have 530 lbs. acting on one side of the wheel, a column of water weighing

* Two-thirds of the value of No. 13 and only half that of No. 14 are here taken, as the contents are respectively 30 lbs. and 20 lbs.


Feet
0
1
2
3
4
5
6
2
6
10
14
18
22
26
30
34
4
8
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16
20
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36
40
1
2
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13
14

446 lbs. re-acting at the same distance from the centre, on the opposite side, will exactly balance the whole 530 lbs. contained in the buckets ; so that about a sixth of the expenditure rests on the axis without producing any useful effect, and the wheel so loaded must remain in a state of rest. Now, in spite of friction and the *vis inertia* of matter, if we suppose the wheel at work, it can raise only 446 lbs. at the expense of 530 lbs. ; but even if it could raise the whole 530 lbs., we should then be but little nearer the mark, for we must remember that the gravitating centre of our power falls through a space of only 8 ft. 11 in., while the water must be raised at least 11 ft. before it could be laid on and delivered clear of the wheel.

As a further means of coming at the end I had in view at the commencement of this letter, I will conclude with a simple rule for calculating the quantity of water a wheel of this kind will raise :—Multiply the number of pounds expended in a minute by the height or diameter of the wheel in feet, divide the product by the height (also in feet) of the reservoir to be filled, and two-thirds of the quotient will be the answer required. Example, for the wheel above described, making six revolutions per minute :—

42 buckets on wheel.
6 revolutions per minute.
———
252 buckets filled per minute.
40 the weight of water in each bucket.
———
10080 lbs. expended per minute.
10 feet height of wheel.
———
11) 100800 momentum, dividing by 11 feet as the height of reservoir.
———
3) 9163·636 dividing by 3.
———
3054·545 multiplying by 2.
2
———
6109·09 answer in lbs.

So that for every 1008 gallons expended on the wheel, we only gain sufficient power to supply 611 nearly.

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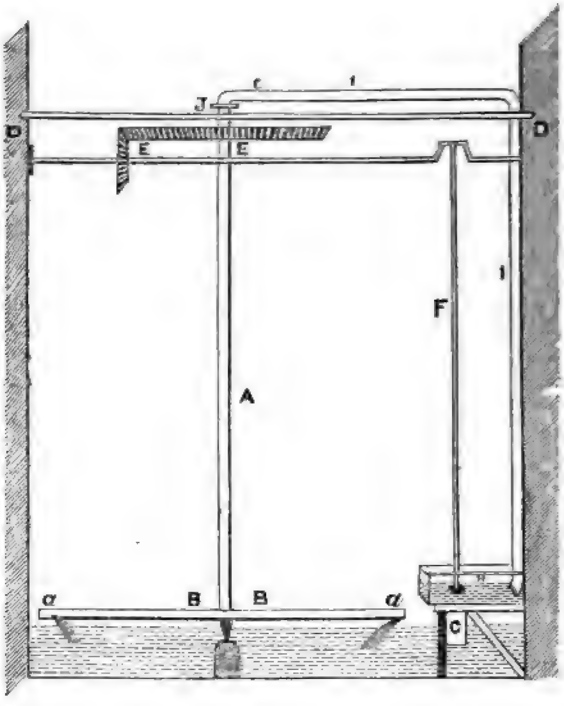
36. SCHEME OF AN HYDRAULIC MOVER, on the principle of Barker's Mill (vol. 15, 1831).—The inventor offers the ac-

companying sketch, with description, of an Hydraulic Mover, for communicating power to machinery, and recently invented by him:—



A is a hollow cylinder or pipe, forming the upright shaft of a mill on Barker's well-known and effective centrifugal principle.

B B, the lateral pipes from ditto; *a a*, the jets of water, whose centrifugal force gives the motion.

C, beam to support the machinery, built at each end into the wall D D.

E E, two cog-wheels to communicate the motion to

P, the rod of a pump (on Shalder's principle), which derives its supply from the well into which the water from the pipes is conducted, which it raises to

H, a cistern into which one end of a syphon, I I, is introduced, the other end of which is soldered with an air-tight joint into the top of pipe A, to which it thus supplies the water which is continually running from the pipes B B, producing a constant motion which may be given by carrying the horizontal rod F through the wall D, to machinery for any purpose. And, if the statement in the pamphlet on Hydrostatics, by the Society for the Diffusion of Useful Knowledge, as to the effect of Barker's Centrifugal Mill, be correct, the power gained must be very great.

The advantages of the invention are obvious. The whole of the machinery for a large factory may be contained underground, which, indeed, will be the most desirable situation for it, and valuable room will thus be saved; the expense of erection will not be great; and the saving in coals, &c., necessary for a steam-engine of the like powers, will be immense. I might, perhaps, have secured much benefit to myself by taking out a patent for the discovery, but I have no wish to profit by monopoly. All I desire is, that it may be recollected that the machine was invented by one who is

A JOURNEYMAN MECHANIC.

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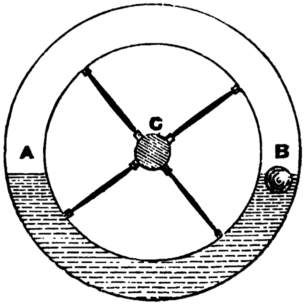
37. THE PARADOXICAL HYDROSTATIC BALANCE (vol. 15, 1831).—After describing it in one form, this correspondent applies it in another, observing:—

This hydrostatic balance, like the compound balance of Desaguliers, may be introduced to illustrate the impossibility of perpetual motion by a weight removed from the centre of a wheel.

Take the hollow-rimmed wheel A B; let it be air-tight and half filled with water. Let C be the axle; at B place a hollow ball loaded to near sinking. Such a wheel, however fine its axle may be, or however well lubricated, will not

make a single revolution, though the weight B occupies that part at which every deluded perpetual-motionist is desirous it



should be placed; concluding that, by such an arrangement, the production of another Orffyrean wheel must be inevitable.

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38. A Project (vol. 18, 1832).—A correspondent writes:—

Will you allow me a small space, to announce to the mechanical world a discovery I made upwards of ten years back, and which I now regret having so long kept to myself; but it has so much prejudice to contend with, that I had determined not to attempt to bring it forward until I could produce ocular demonstration of the fact. However, as constant employment in a totally different line of business will in all probability prevent my doing so for many years to come, I have resolved upon explaining the nature of it, and soliciting the advice of your readers on the subject. The discovery consists of a simple method of raising a weight, by the descent of an equal weight, to a height equal to the descent, which I believe has never yet been accomplished. But if that were the whole merit of the discovery, it would be of little consequence and less utility. The case is, however, otherwise, there being a considerable disposable power over and above what is required to bring up the weight. I am well aware that nothing short of ocular demonstration will

convince you and many of your scientific readers of the possibility of my statement being correct; but, if any of your numerous correspondents will point out a practicable method, whereby I can procure a moderate remuneration (bearing in mind that it is not in my power to take out a patent), I will engage to convince the most sceptical of the truth of what I assert.

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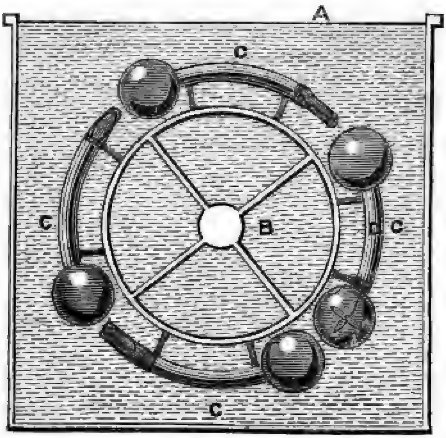
39. Two "CERTAIN" PLANS FOR PRODUCING PERPETUAL MOTION (vol. 21, 1834).—A correspondent, under this title, writes:—

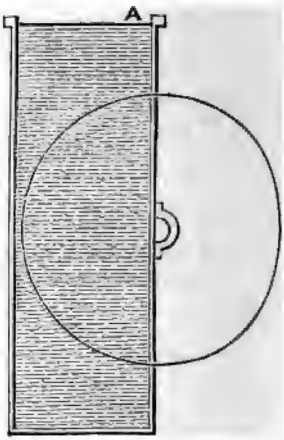
Very few young mechanicians escape being seduced into an attempt to produce a perpetual movement, by making gravitation counteract itself. They are not contented with being told by older men, that a cause can never be made to exceed its own power; yet gravitation is expected by them to lift up on one side more weight than sinks on the other, with some per centage of friction into the bargain. Nature, however, is too true to itself to be so taken in by all or any of the multitudes of various ways the inventive genius of man has contrived, and still keeps contriving, to circumvent her immutable laws, with no other effect than to render the case so complicated as to puzzle the judgment of the inventors, which ends usually in their firm belief that they have outwitted nature instead of themselves. I acknowledge that in my youth I was one of this class, and, for the benefit of the young, I beg to present you with two *certain* plans for producing perpetual motion, and compelling gravity to be frolicsome, and do more work than she ought.

Let A (Fig. 1) be a cistern full of oil or water, above 4 feet deep. Let B be a wheel; freely suspended within it, on its axle, let there be four wide glass tubes, 40 inches long, *c c c c*, having large bulbs, holding, say a pint, blown at the closed end. Fill these tubes with mercury, fix on an Indian-rubber ball or bladder, that will hold a pint, to each of them at the open end, and let them be attached round the wheel, as exhibited in the figure. As the pressure of 40 inches of mercury will exceed the atmospheric pressure, and also that of the four-feet column of water, when the Indian-rubber bottle is lowest, and the tube erect, as at D, the mercury will

fill it, leaving a vacuum in the glass bulb above. On the opposite side the mercury will fill the glass bulb, and the Indian-rubber bottle will be pressed flat, as will also be the case in the two horizontal tubes. Now, it is evident that the two horizontal tubes exactly balance each other; but the tube D, with its bulb swelled out, displaces a pint of water more than its opposite tube, and hence will attempt to rise with the force of about one pound; and each tube, when it arrives at the same position, must produce the same result, the wheel must have a continual power, equal to about one pound, with a radius of two feet.—Q.E.D.

(*Fig.* 1.) (*Fig.* 2.)





Let Fig. 2 represent a light drum of wood—one half of which is inserted into a cleft in a water-cistern A, which fits it, and from which the water is prevented from escaping by a strip of leather, which the water presses against the drum, and which thus operates as a valve, without much friction (especially if oil be substituted for water in the cistern). Now, as this drum is much lighter than water, it must ever attempt to swim, and thus, in perpetually rising, cause the drum to revolve forcibly round its axle.—Q.E.D.

I tried this last method thirty years ago, but it was so

obstinate as not to move one inch at my bidding, though it obviously is proved, to demonstration, that it ought to have gone on swimmingly. I have just heard that an Italian gentleman has hit upon the same plan; so it seems that the mania is not confined to England.

[The remarks of a correspondent respecting the foregoing, called forth the following observations from the Editor :—]

We think our correspondent, S. F., has entirely misconceived the scope of the playful account, given in our last number, of two plans of perpetual motion. The object of the writer seems to have been, to impress on the minds of young mechanicians the folly of wasting their time in vain endeavours to render the effects of causes greater than the causes themselves; or, in other words, to gain power out of nothing —a process without limit or value, were it not cut short by the want of all limit to its folly; and this he could not, perhaps, have done in any way so well, as by exhibiting a couple of infallible perpetual movers that would not stir at all, though they bade as fair for it as any of their kindred.

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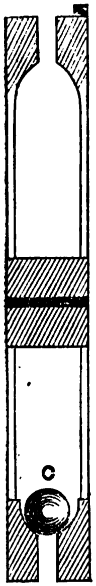
40. Essay at Perpetual Motion (vol. 26, 1836).— F. S. Mackintosh says :—

I herewith forward you a description of a machine which was constructed by me in the year 1823, with a view to produce a perpetual motion. With this machine, and the studies necessarily connected with it, first originated the suspicion that the planets could not continue in motion unless they gradually approached the centre of attraction.

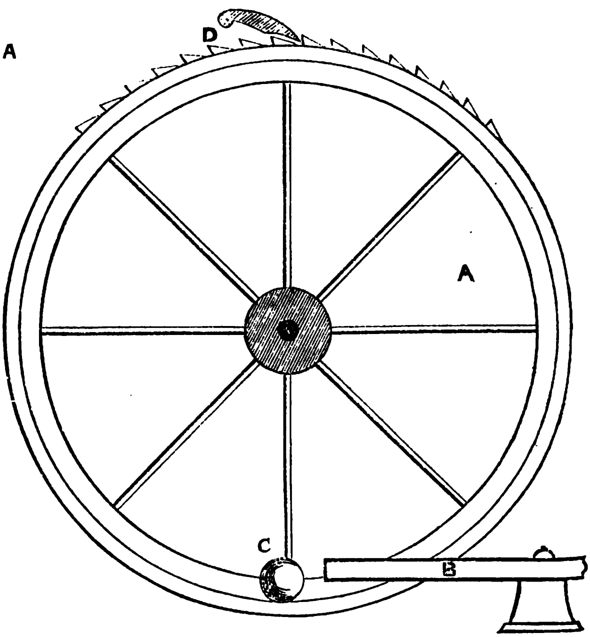
In the first place, let us describe the machine. Fig. 1: A is a sectional view of the interior of the wheel, which is formed in two halves upon one shaft; each half or section is furnished with a projecting ledge, and an opening is left between the two ledges sufficiently wide to admit of a magnet being introduced between them, by which arrangement the magnet may be brought as near to the ball as may be necessary (see Fig. 2). B is a magnet, whose line of attraction acts at right angles with the line of gravity. C is an iron ball, under the action of two forces. The magnet continually drawing the ball up the inclined plane within the wheel, and gravity continually drawing it to the bottom, by their united

action it was supposed the wheel would revolve for ever, or till it was worn out; upon the same principle that a wheel revolves by the animal force or muscular action of a mouse or squirrel, which carries it up the inclined plane, whilst it is

(*Fig.* 2.)



(*Fig.* 1.)



continually drawn to the bottom by the action of gravity, thereby causing the wheel to revolve by the weight of its body. The model was taken from the earth's motion round the sun; and the following process of reasoning seemed to justify the assumption that the wheel would move on till it was worn out:—

"The earth is carried round the sun by the action of two forces, one of which is momentum, which is not, in reality, a force or cause of motion, but an effect derived from an original

impulse; and that impulse, or the momentum derived from it, is not destroyed, because there is no resistance to the moving body—that is, there is no friction. Well, I cannot make this machine without having resistance to the motion—that is, friction; but to compensate for this, I have two real forces, two causes of motion, each of them capable of imparting momentum to a body: they are both constant forces; and from one of them, the magnet, I can obtain any power that may be required within certain limits."

This reasoning appeared conclusive, and the wheel was made; but when the magnet was applied, instead of the ball rolling up the inclined plane, the wheel moved backwards upon its centre. It occurred to me, that by placing a small ratchet upon the wheel, as shown at D, this backward motion of the wheel on its centre might be prevented, in which case the ball must roll up the inclined plane, and that a perpetual motion might then ensue; but this ratchet I never tried, having about that time begun to perceive that the idea of a perpetual mechanical motion, either on the earth or in the heavens, involves an absurdity; and that, therefore, the motions of the planets must necessarily carry them continually nearer and nearer to the centre of attraction.

TRIAL OF THE FOREGOING PLAN (vol. 26, 1836).—By R. Munro, who says:—

The result of Mr. Mackintosh's essay at perpetual motion might be attributed to the avoidable friction caused by the manner in which the iron ball is placed in the wheel. Curious to try the experiment, I proceeded, and, with the view of diminishing the friction, I placed two wheels on the axis of the ball, but the result was precisely that described by Mr. Mackintosh. I next applied the ratchet, as suggested, but with no better effect; the ball rolled towards the magnet, but did not give the required motion to the wheel. It is not unlikely, then, that the present ingenious attempt will not be realised.

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41. AN ATTEMPT AT PERPETUAL MOTION (vol. 44, 1846). —An "Amateur" writes:—

The account of an attempt to realise this idea, though a

failure, may not be wholly uninteresting, as not only may experience be gained even from errors, but also trouble saved to others in enabling them to avoid them. Suppose, then, that the buoyancy in water of a flat piece of wood, when its surface lies either horizontal, or more or less so, is greater than that of a similar piece when perpendicular. Connect two thin floats of wood by a slip of wood turning on a centre; the floats joined to the connecting strip by hinges, so that the one descends on one side edgeways, but the other in its rise doubling up inwards against the connecting strip, draws down the other below its own level; at which point the power appears to be gained. Now, more floats added, equal on both sides, it might be supposed that they would draw one another round the extreme lowest point, and thus a continual rotary motion be produced; the same thing becoming alternately the greater and less power. Such, however, on experiment, proves not to be the fact.

SECTION IV.—*Claims to Discovery.*

1. ALLEGED DISCOVERY OF PERPETUAL MOTION.—A correspondent in "Drakard's Stamford News" makes the following communication:—"Since the death of Sir Isaac Newton, it has been the study of thousands of little and contracted minds to discover the long-wished-for perpetual motion; but, doubtless in consequence of Sir Isaac's opinion, the completion of the thing has scarcely ever engaged the mind of a philosopher. However, when he has been immortalized for one century (which will be on March 20th, 1827), your present correspondent, a friend to society, will offer to the public (on contribution of the promised sum*) a motion that will then have continued eleven years. For its completion he has spared neither time nor expense, and, above all, has omitted that which the vulgar ever found to decay. It consists of that which is not foolish or nonsensical, such as springs, balance, and weights, but of materials which will continue a century as well as one day. No weight is too

* A vulgar error, we suspect. We know of no sum that is promised. —ED. "Mec. Mag."

immense for its motion, and the mechanic's art shall be baffled at its velocity."—["Mec. Mag.," vol. 1, 1823-4, p. 252.]

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2. A Perpetual Motion Advertised.—This subject has so frequently occupied your attention, and that of your contributors, that the following advertisement in the "Edinburgh Courant," 15th December, 1707, may probably be thought worthy of a corner in your valuable work:—"These are giving advertisement that in pursuance of some overtures given in by Mr. Robert Stewart, Minister of the Gospel, in January and February last, in the 'Edinburgh Courant,' concerning the *perpetuum mobile*, and for the further satisfaction of mankind, and clearing their scruples, anent the same; there was a curious model made at the charge of John, Earl of Breadalbane, which model will demonstrate the possibility, probability, and practicability of these three new discoveries, viz.: Firstly, a balance, by which an equal overcomes an equal at the same time. Secondly, that being granted, a weight always going down, and never going lower. Thirdly, these being granted, a clear idea of the *perpetuum mobile*. If any man doubts any of these propositions, the model is brought to town," &c., &c.—[Vol. 9, 1828, p. 432.]

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3. Alleged Discovery of Perpetual Motion by Richard Van Dyke.—(From the "Philadelphia Gazette.")—We were much gratified yesterday with the result of an examination of a self-moving machine, which may be seen at Bowlsby's Merchants' Hotel, in Slater Street, and which the inventor calls a perpetual motion. We have no doubt of its being nearer a perpetual self-moving principle than any invention that has preceded it, and as near as any we shall ever see. The great merit, aside from its practical uses, is its simplicity, and the certainty and readiness with which you perceive that it covers no trick or deception. It is little less than an illustration of one of the most obvious laws of nature. The agent is the atmosphere, bearing directly, by means of perpendicular boxes and oblique tubes, upon the buckets of a wheel, which is propelled with greater or less

velocity, but which is constantly propelled, and will continue to run, without the possibility of cessation, while the materials of which it is composed last, and the present laws of nature continue. The inventor is Mr. Richard Van Dyke, of Orleans county, in this State, who gives it as the result of five or six years' application to the subject. He is a venerable man, communicative and intelligent, and described as highly respectable by several citizens of the West, on whose representations entire reliance may be placed. He affects no mystery, but clearly and satisfactorily explains the arcana of the machine."—[Vol. 12, 1829-30, p. 55.]

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4. Alleged Discovery by R. W. Franklin.—I have read a great deal in your Magazine about perpetual motion, and have studied this disheartening question many years before your work began. In No. 319, I see there is an account of a perpetual motion invented by one Richard Von Dyke, of America. I do not suppose any one can understand what that machine is from such an account; but no doubt it was the best you was able to procure. I verily believe that I invented the same thing a few months ago, but was prevented from putting it to the test of experiment by great troubles in my family. If a few of your correspondents will favour me with their addresses, I will appoint a time and place to have their united opinions on my scheme. But I hope no one will apply to be of the number who does not know something about pneumatics: I do wish that person to be one who wrote on the subject, page 399, No. 312.—I remain, Sir, your humble servant,

R. W. Franklin.

North Place, Wilsted Street, Somers Town.

P.S.—When the gentlemen have examined my drawings, I wish some one of them to give your readers an account of it.—[Vol. 12, 1829-30, p. 192.]

The following is from the same claimant:—

I have within the last three months made very great improvements in my plan, so as to increase its power fifty times, that is, by making the wheel to work in water only, instead

of water and air. Success is certain. Its power may be as easily calculated as the common overshot water-wheel, and a wheel on this plan may be made of fifty-horse power. Twenty years ago I had a good working knowledge of the five mechanical powers, and was always of opinion that a self-mover could not be made by any of them. I determined never to look for it anywhere but in the sciences of hydraulics and pneumatics. I had a short correspondence with Lord Stanhope on this subject in the year 1815. I have began to make my machine, and can defray the expense myself; it is now half finished; but I shall want the assistance of some person of property and ability to take out a patent. As I am obliged to proceed slowly, I think I had better look for that assistance at once. My machine will, in eight cases out of ten, abolish the steam-engine, and will not cost twenty shillings to work a year.

You have my address, and will probably be kind enough to take charge of any letters which may be addressed to me. —I am, &c., R. W. FRANKLIN.

August 29, 1830.

P.S.—If all my expectations are realised, it will be the most important invention this country can boast.—[Vol. 14, p. 13.]

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5. SELF-WINDING CLOCK.—The "Connecticut Register" states that a person in that State has invented a clock which winds itself up, and keeps correct time, and strikes the hour regularly, and will continue to run until worn out, without the application of any power external to itself.—[Vol. 12, p. 255.]

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6. WRIGHT'S PERPETUAL SPHERE.—It is related in Hutton's Dictionary that Edward Wright, the mathematician, made for his pupil, Prince Henry (son of James VI.), a large sphere, and "there was in it a work for a motion of 17,100 years, if it should not be stopped, or the materials fail." "This sphere," it is added, "though thus made at a great expense of money and ingenious industry, was afterwards, in the time of the civil wars, cast aside amongst dust and rubbish, where it was found, in the year 1646, by Sir Jonas

Moore. who, at his own expense, restored it to its first state of perfection, among his other mathematical instruments and curiosities." Query, Is this curiosity still extant?—[Vol. 15, p. 288.]

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7. SELLERY'S HYDRAULIC SELF-ACTING ENGINE.—Mr. Charles Doyne Sellery has invented a new engine, which he terms the "Hydraulic Self-acting Engine." It works by the pressure of the atmosphere, and is said to possess a power equal to six times that of the steam-engine! Another remarkable character of this powerful engine is, that it neither requires fire, wind, nor water; and when once set going, works without any assistance whatever!—*Exeter Flying Post.* —["Mec. Mag.," vol. 17, p. 224.]

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8. BUCKLE'S PERPETUAL MOTION.—A correspondent in North Berwick writes as follows:—"Mr. William Buckle, a respectable tradesman of this place, has, after many years' close study and observation of the celestial bodies, discovered the perpetual movement. He has not only discovered wherein longitude consists, but longitude itself to an azimuth. He has prepared tables by which his calculations can be carried to any extent, and by which he can, at any time, and under the most unfavourable circumstances, ascertain the longitude with the same facility and correctness as latitude is at present by the nautical instruments now in use. These latter are entirely superseded by the use of an instrument constructed by himself, of the most simple description. He has every confidence in being able to explain and defend the principles and correctness of his discovery to any one, and is, at this time, endeavouring to bring it under the notice of Government."—*Scotsman.*—["Mec. Mag.," vol. 19, p. 368.]

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9. TOWNSEND'S PERPETUAL MOTION.—The announcement in our last number, by Mr. Wm. Pearson, that he has discovered a veritable perpetual motion, has brought us another to the same effect from a gentleman who, like Mr. Pearson, disdains to "shrink behind an anonymous signa-

ture," and glories (or hopes to glory) in the name of Thomas Townsend, of Chancery Lane, London. He twits Mr. Pearson with having never tried whether his machine would really go for ever—(Is not this asking too much?)—and says that he has actually made a model of his which has worked so well that he means forthwith to make one on a larger scale.—[Vol. 20, 1834, p. 304.]

10. DR. STRINGFELLOW'S PERPETUAL MOTION.—By the "Georgia (American) Messenger," we learn that a Dr. Stringfellow, of Macon, has actually discovered the long-sought and never-before-found perpetual motion. The Editor thus partially describes it:—"The machine is very simple, the whole consisting of a very few pieces, yet comprising the most ingenious and the most perfect principles of mechanism. It is comprised within a square frame of about eighteen inches, and the parts consist only of two perpendicular spindles and two horizontal cog-wheels, a trundle-head, three small suspension chains, a spiral spring and weight, and a small inclined plane."—*Weekly Chronicle.*—["Mec. Mag.," vol. 27, 1837, p. 160.]

11. EXTRAORDINARY MECHANICAL INVENTION.—A gentleman at Milton-next-Gravesend, who for many years carried on an extensive business at Ramsgate, after eleven years' study has succeeded in completing some machinery which will, when brought into use, he imagines, supersede the use of steam power. It may, he thinks, be applied to clocks of any description, requires no winding up when put together, and will continue going so long as the materials last.—(Correspondent of the "Times.") The writer of this announcement might, quite consistently, have added at the end of it—"and for some time after."—"Mec. Mag.," vol. 38, 1843, p. 48.]

12. JOSEPH HUTT'S PERPETUAL MOTION MACHINE.—A correspondent of the "Midland Counties Herald" says:—"A framework knitter of Hinckley, named Joseph Hutt has,

after twenty years' application and study, completed a machine which he calls a 'self-moving machine,' or 'perpetual motion.' He set it in motion the 26th August last, since which time it has continued to work with the greatest regularity. The motions of the machine are both quick and powerful, and may be greatly increased, and applied to any purpose. It does not require the aid of steam or any other power to keep it in motion, having one continual and regular movement of its own. Hutt, who is a poor man, is anxious to obtain assistance to enable him to test still further the value of his invention."

The best thing which the friends and neighbours of this "poor man" could do for him would be, to make him a present of some standard work on mechanics—(say Gregory or Moseley)—from which he would learn that the object he is aiming at is a positive impossibility.—[Vol. 47, 1847, p. 463.]

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13. HENDRICKSON'S DISCOVERY OF PERPETUAL MOTION, IN AMERICA.—The following is an extract from the "Times" of Thursday:—"Mr. J. G. Hendrickson, of New Jersey, announces the discovery of the principle of perpetual motion. The success is obtained by the employment of arms and balls attached to a cylinder so as to keep the extra weight always on one side, and, therefore, to give the cylinder a constant inclination to turn round. The machine requires no starting. Take away the blocks, and it goes off like a thing of life. The 'Journal of Commerce' says of it:—'The model was in our office yesterday, and attached to some clockwork, which it turned without once stopping to breathe. We see no reason why it should not go until worn out! After a careful examination, we can safely say, in all seriousness, that the propelling power is self-contained and self-adjusting, and gives a sufficient active force to carry ordinary clockwork, and all without any winding up or replenishing.'"—[Vol. 61, 1854, p. 326.]

PERPETUAL MOTION—PATHETIC STORY OF ITS INVENTOR, HENDRICKSON.*—About fourteen years ago we

* This account, from an American paper, is here introduced to complete the foregoing article.

published the first description of a machine invented by Mr. James G. Hendrickson, of Freehold, N. J., "to go of itself." A model, which Mr. H. has made, after patient whittling for forty years, was brought into our office, and we found that it would go without any impulse from without, and would not stop unless it was blocked. The power was self-contained and self-adjusted, and gave a sufficient force to carry ordinary clockwork without any winding up or replenishing. In short, we saw no reason why it would not go until it was worn out. The inventor was an old man, who had spent his whole life in pursuit of the object he had now attained. He was invited to be present at various fairs and exhibitions of new inventions, and wherever he went, his machine formed one of the chief attractions. The professors were all against him. Accordingly, Mr. H. was seized at Keyport, N. J., for practising "jugglery," under the "Act for suppressing vice and immorality." To expose the supposed trick, an axe was brought, and the cylinder splintered into fragments. Alas! for the philosopher, there was no concealed spring, and the machine had "gone of itself." (He made a new machine.) His model once more completed, was constructed of brass, hollow throughout. (He sent a working model to the Patent Office, Washington.) The moment the blocks were taken out, the wheels started off "like a thing of life;" and, during ten months, it never once stopped. The inventor had perfected two new machines, and made a very comfortable livelihood exhibiting them, prosecuting his efforts meanwhile to secure his patent. Age crept upon him, however, before this point was reached; and last Saturday afternoon he breathed his last at Freehold. The night after his death his shop was broken open, and both models stolen. Fortunately, the drawings are preserved, and there is a little machine, one of the earliest made, now running in Brooklyn, where it has kept up its ceaseless ticking for nearly twenty years.—*New York Journal of Commerce.*—[Abridged from the "Scientific American," New York, 26th November, 1859, the Editor of which states:—"We saw the selfsame story going the rounds of the press some eighteen months ago, and it is now revived with the sad intelligence of the inventor's death."]

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14. CHENHALL'S PERPETUAL CLOCK.—[The following

letter is from a gentleman of undoubted honour, and who is above all interest in the ingenious tradesman of whom he writes.—Eds. M. M. :—]

I believe it has been the custom, from time immemorial, among nine-tenths of our scientific people, to view the hitherto occult theory of perpetual motion as a chimera, and to regard the remaining few, who will still, night after night, expend their midnight oil in efforts to bring the said occult principle to light, with as little sympathy as those who once dreamed away the better part of their existence while groping for the philosopher's stone.

In a small out-of-the-way street of Plymouth (Drake-street) there is exhibited, in the shop-window of a watchmaker named Chenhall, a clock of the size of an ordinary eight-day clock, with a novel and exceedingly simple movement, and which, simple as it appears, is nevertheless said to be gifted with the property of going as long as the durability of the materials permits, without the aid of weight or spring; in short, without any manual assistance whatever.

I beg to state that I have no personal interest in the affair whatsoever, nor am I even acquainted with the nature of the unseen agency which has been called in by Mr. Chenhall to effect his purpose, and which the latter does quite right in concealing from public view; but this I know, that the hidden part occupies but a very small space, and that one glance at the mechanism which is visible, seems to me sufficient to satisfy the most sceptical that Mr. Chenhall's assertions may be relied on.—A Subscriber. Plymouth, May 1, 1858.—[Vol. 68, 1858, p. 447.]

Section 5.—*Impostures.*

Perpetual Motion Impossible.—An impostor exposed. —A correspondent, who signs "Mactaggart," makes, among other, the following reflections on perpetual motion :—

* * * In vain did the ancient Egyptians employ their black arts to find it out; in vain did the mathematicians of the school of Alexandria club their thoughts together respecting it. * * * *

Yet, though this dark secret has never been found out, nor ever will, it has been of mighty use to the advancement of the arts; for mankind, in searching for it, have found many other things of very great value. * * *

Mystery has ever been a thing of great value to mankind; it is indeed the mother of curiosity. * *

Since, now-a-days, to all informed minds, perpetual motion seems at once a thing of entire impossibility to find out, it must surely be a great folly in any artizan or man of genius to waste his days and his substance in order to make the discovery: the thing is Nature herself, on one of her grandest scales; it is the utmost presumption, therefore, in man to dare to mimic her. The ocean, as it ebbs and flows, is a perpetual motion; death and life on the earth also are the same thing; and obvious to all are the ever-wheeling orbs in the firmament of heaven.

The Almighty has wisely ordered that nature should ever be in continual motion, never stable; the continual movement is therefore an invention of the Deity, for his rational creatures to contemplate and do little else with, as the causes by which it is actuated are concealed from our feeble comprehensions in impenetrable darkness: we may say they are gravity, attraction, and so forth; but what these are we know not; they are only names we give to causes, whose properties are unknown—the workmen, we may say, who do stupendous things, which set us a wondering, but to whom we are entire strangers. * * * * *

However, let us farther treat of man trying to imitate with his arts this grand moving spectacle of his Creator. The nearest approach he has ever made towards it (though, at the same time, we say it is just as far from it as any) is the simple pendulum; and were it possible to swing it free of friction, in a complete vacuum, it is likely the thing would be accomplished; but as this is not possible, a continual motion cannot be obtained.

Many have fancied that the elements of nature may be so brought to act on each other, that a movement of this kind may be had; but these trials, one after the other, have all failed; perhaps efforts with magnetism have oftener been tried than any, as it has both the virtue of attraction and repulsion; but these have been attended with no greater success than the rest, though many impostors have appeared

from time to time, who have reported that they had, with deep study and much difficulty, found out the important secret.

One of those quacks, a few years ago, so far imposed on the good people of Scotland, who inhabit the country places and small villages, with an article which he had made, purporting to be this famous motion, that he extracted a good deal of cash out of their pockets, by its exhibition. At length he had the hardihood to go to Edinburgh, the modern Athens, with it. Instantly his puffing handbills brought hundreds about him, all anxiously wishing to have a sight of the wonderful machine. Amongst others who paid to get in to behold it, was an ingenious young artist, who, after looking at it for a little while, like the rest, requested very politely the inventor's leave to examine it in his hand. It was a beautiful thing, certainly, to look at. An inverted glass bulb, about six or eight inches high, and about five in diameter at the mouth, was placed on a mahogany bottom, about the one-fourth part of an inch in thickness, round the side of the glass; in the interior stood six pieces of metal, which went under the name of magnets; in the centre of the whole, on a delicate pedestal, was seen something rather thicker than a needle, moving slowly round: and this was the perpetual motion.

The young mechanic began his observations upon it by examining minutely with a microscope round the thin edge of the mahogany bottom, and was not long before he found something like a hole, with a stop very neatly put in it; this stop he soon extracted, and holding it up to the crowd, said, "This is the place by which the key is inserted, that winds up a thin coiled spring, by which the motion is kept apparently perpetual."—[Vol. 1, 1823-4, p. 253.]

A Perpetual Motion Imposture, from America.—A person "just arrived from the United States of America," is going the round of our provincial towns, exhibiting what he styles "one of the grandest pieces of mechanism that was ever presented to the world," being nothing less than the "perpetual motion which was long sought for by the great Sir Isaac Newton, and since by men of all nations of the

very first talents in the arts and sciences." "This grand machine" is said to have worked ever since it was first invented—upwards of seven years—and will continue to work without any assistance whatever, but by the power of its own gravity, balance, and pivots, as long as the world stands; or, in other words (if the materials it is made of would last), for ever!" We are further assured "that it has been exhibited in the United States, and all the principal towns in the West India Islands; and is allowed, by men of genius, and by those who are acquainted with mechanical powers, to be one of the most wonderful and extraordinary pieces of machinery that was ever invented in the world, reflecting the highest credit on the inventor, for his patience and perseverance for upwards of fifteen years study on this invention."

The "inventor" of this wonderful wonder having lately honoured the city of Norwich with a visit—for "a short time" only, however, while he "waits the decision" of the Royal Society of London, to whom he has applied for "the premium offered by Government" (there is no premium)—the mayor thought proper to direct a friend in London to inquire whether Mr. Perkins knew anything of this American prodigy.

Mr. P. told the inquirer that he had once actually travelled 400 miles in America to see a piece of mechanism which he believed to be similar, but that having found it to be all a deception, it had been broken to pieces by the populace.

An intelligent correspondent at Norwich, who examined the apparatus, has explained to us pretty clearly in what the deception consisted; but without an engraving (which would be thrown away on such a piece of trickery), his deception would not be intelligible to our readers.

It may suffice, for the information of our country friends, to mention that the concealed cause of motion is thought to lie in the plinth, and that it seems to consist of "machinery attached to the lower part of the trundle, worked by a spring like the pocket-watch. The "planes, &c., upon the wheels are mere gew-gaws, to divert the attention from the real cause."—[Vol. 2, 1824, p. 361.]

ADAMS' PERPETUAL MOTION IMPOSTURE.—I beg to inform you of a Scotsman, much marked with the small-

pox, and whose name, according to his handbills, was Adams, about two years since exhibited, for eight or nine days, his pretended perpetual motion at this place, and, I believe, took the natives in for fifty or sixty pounds. Accident, however, led to a discovery of the imposture. A gentleman, viewing the machine, took hold of the wheel or trundle, and lifted it up a little, which, I suppose, disengaged the wheels that connected the hidden machinery in the plinth, and immediately he heard a sound similar to that of a watch when the spring is running down; the Scotsman was in great anger, and directly put the wheel into its proper position, and the machine again went round as before. The circumstance was mentioned to an intelligent person, who determined to find out and expose the imposture, and took with him a friend to view the machine; they seated themselves one on each side the table upon which the machine was placed; they then took hold of the wheel and trundle, lifted them up a little; there being some play or liberty in the pivots, directly the hidden spring run down. They continued to hold the machine in spite of the endeavours of the Scotsman to prevent them. When the spring had run down, they placed the machine again on the table, and offered the Scotsman fifty pounds if it could then set itself going. Alas! notwithstanding his fingering and pushing, it remained motionless. A constable was sent for, the impostor went before a magistrate, and there signed a paper confessing his perpetual motion to be a cheat. He was suffered to go at large upon promising to leave the town.—[Vol. 3, 1824-5, p. 364.]

THE FINCH LANE PERPETUAL MOTION IMPOSTURE.—I observed some time back in your excellent work, a supposed refutation of what was stated to be a perpetual motion, by a man in Finch Lane. This man stated that he could stop the machine (merely a ball hanging to a long spring), and that it would set itself agoing without his interference. The machine certainly did this, and at first puzzled me a good deal; and the reason of my writing to you now about it, is to expose the imposition in the proper manner. I may here remark that the man has shown considerable ingenuity (as I believe the idea to be quite new), though he certainly is an impostor. Below the ball was an orifice, and through this, the air from

without the room was conducted immediately upon the ball, which it set in motion, and continued to accelerate, until it had received, by continually passing over the hole, the full effect of the stream of air. The weather being warm, and yet observing a fire in the room on both my visits, was what led me to the discovery; and on endeavouring to keep open the door by which I entered, the man interfered; but I did so long enough to lessen considerably the motion of the ball, by partly destroying the current of air.—[Vol. 4, 1825, p. 302.]

REDHŒFFER'S PERPETUAL MOTION IMPOSTURE.*—In the year 1813, a belief in the delusive principle of perpetual motion was created throughout a considerable portion of the community of the United States, by a deceptive machine, constructed by one Redhœffer, and had gained sufficient character to induce an inquiry into its reality by the appointment of a committee of the Legislature of Pennsylvania. The attention of Mr. Lukens was turned to the subject, and although the actual moving cause was not discovered, yet the deception was so ingeniously imitated in a machine of similar appearance made by him, and moved by a spring, so well concealed, that the deceiver himself was deceived; and Redhœffer was induced to believe that Mr. Lukens had been successful in obtaining a moving power in some way in which he himself had failed, when he had produced a machine so plausible in appearance as to deceive the public.—*Franklin Journal.*—[" Mec. Mag.," vol. 46, 1847, p. 239.]

MISCELLANEOUS JOURNALS.

Having thus concluded the classified extracts from the " Mechanics' Magazine," we now proceed with quotations from miscellaneous journals :—

PERPETUAL MOTION.—In an article on " Mental Delusions," in the " Penny Magazine " for 1841, the following, among other cases, occurs :—

In the reign of Anne, a gentleman named Stukely† left his

* See also " Gill's Tech. Journal," quoted in Chap. VIII., p. 222.

† See also Chap. VIII., p. 226.

practice as a barrister, and retired into the country to perfect his discovery of the perpetual motion, and never left it but once for thirty years, when he took the oath of allegiance to George I., and on which occasion, for the only time, he shaved, and changed his shirt and clothes. Before he died, he had abandoned his pursuit of the perpetual motion, and would laugh at his own folly in confining himself in-doors.—[New Series, folio, p. 409.]

ON THE IMPOSSIBILITY OF PERPETUAL MOTION, we take the following from the "Magazine of Science:"—

If by perpetual motion be understood a power which moves, and which will move to the end of time, without regard to the wear and perishable nature of materials, it is in vain to expect such can be made by human means and human intelligence, however much we may hope for future discoveries in science to aid us. In the works of God alone must we look for such perfection and continuity of motion. We can only abide by those laws already in action, and must therefore construct our machines according to these previously-arranged impulses; and unfortunately for the visionary schemer of the perpetual motion, these laws are too stubborn for him to modify, much less destroy. Even supposing he should content himself with an apparatus which would move only while its materials held together, the resistance of the air, the friction of the various parts, their *vis inertiæ*, and the general laws of gravitation, are impediments never to be overcome; and although all have failed, yet much ingenuity has been exerted, and talent called into exercise, by the many attempts which have been made to surmount them.

Mechanics, particularly the known properties of the lever, have given rise to innumerable schemes. One was called "The Valley Windmill." This consisted of a wheel with five arms, each arm made of two pieces connected end to end by a joint. When made to turn round, the jointed ends on one side fell back, or rather hung down from the end of the fixed part of the arm; rising to the greatest elevation, it hung close to the fixed arm; passing beyond this, it fell back towards the centre; and thus by its position making a shorter lever, it bore with less weight; but when it had gone a little

further, altering its centre of gravity, it fell down suddenly, when the moveable and fixed arm became one long lever, much heavier than in any other position, and this extra weight was to turn the whole. The machine had but one fault—it would not go. "The Wheel of Balls," described by the Marquis of Worcester,* was another scheme. This was a very shallow drum, divided into a number of compartments, into each of which a leaden ball was placed, and as the wheel turns round each ball rolls alternately to and from the centre of the wheel; and it would seem, from the principle of the lever, that, as the weights are always further from the centre on one side than on the other, a continuous rotatory motion must be produced; but it was found that though the balls were thus placed, yet a very few of them were away from the centre, while there were many near to it; thus, those on one side counteracted those on the other, and, as in the other instance, the machine would not go.

Hydraulics, pneumatics, and chemistry, all lent their aid, but in vain. Water-wheels were to throw up water enough to turn themselves. Pumps were to move by self-created power. Water-balances were alternately to rise and fall by each other's weight. Blasts of air were to work bellows, and the bellows were to produce blasts of air. Hydrostatic parodoxes became numerous. Barker's mills were in requisition.

[The article next proceeds to notice the results of electricity, giving an account of "De Luc's Dry Pile, or Electrical Column and Melloni's Rotatory Pile."]—[Edited by G. Francis, F.L.S. Vol. 1, 1849, p. 194.]

On the Impracticability of Producing a Perpetual Motion.—Perpetual motion is a motion which is supplied and renewed from itself, without the intervention of any external cause: to find a perpetual motion, or to construct a machine which shall have such a motion, is a subject which has engaged the attention of mathematicians for more than 2000 years; though none perhaps have prosecuted it with so much zeal and hopes of ultimate success as some of the speculative philosophers of the present age.

* The Marquis describes a very different wheel.

Infinite are the schemes, designs, plans, engines, wheels, &c., to which this longed-for perpetual motion has given birth; and it would not only be endless but ridiculous to attempt to give a detail of them all, especially as none of them deserve particular mention, since they have all equally proved abortive; and it would rather partake of the nature of an affront than a compliment, to distinguish the pretenders of this discovery, as the very attempting of the thing conveys a very unfavourable idea of the mental powers of the operator.

For among all the laws of matter and motion, we know of none which seems to afford any principle or foundation for such an effect. Action and re-action are allowed to be ever equal; and a body which gives any quantity of motion to another, always loses just so much of its own: but, under the present state of things, the resistance of the air, and the friction of the parts of machines, ncessarily retard every motion.

To keep the motion going on, therefore, there must either be a supply from some foreign cause, which, in a perpetual motion, is excluded:

Or, all resistance from the friction of the parts of matter must be removed; which necessarily implies a change in the nature of things.

For, by the second law of motion, the changes made in the motions of bodies are always proportional to the impressed moving force, and are produced in the same direction with it; no motion, then, can be communicated to any engine, greater than that of the first force impressed.

But, on our earth, all motion is performed in a resisting fluid, namely, the atmosphere, and must therefore, of necessity, be retarded: consequently, a considerable quantity of its motion will be spent on the medium. Nor is there any engine or machine wherein all friction can be avoided; there being in nature no such thing as exact smoothness or perfect congruity; the manner of the cohesion of the parts of bodies, the small proportion which the solid matter bears to the vacuities between them, and the nature of those constituent particles, not admitting it.

Friction, therefore, will also in time sensibly diminish the impressed or communicated force; so that a perpetual motion can never follow, unless the communicated force be so much greater than the generating force as to supply the diminution occasioned by all these causes; but the generating force

cannot communicate a greater degree of motion than it had itself. Therefore, the whole affair of finding a perpetual motion comes to this, viz., to make a weight heavier than itself, or an elastic force greater than itself; or, there must be some method of gaining a force equivalent to what is lost, by the artful disposition and combination of the mechanical powers: to this last point, then, all endeavours are to be directed; but how, or by what means, such a force can be gained, is still a mystery!*

The multiplication of powers or forces avails nothing; for what is gained in power is lost in time; so that the quantity of motion still remains the same.

The whole science of mechanics cannot really make a little power equal or superior to a larger; and wherever a less power is found in equilibrio with a greater—as, for example, twenty-five pounds with one hundred—it is a kind of deception of the sense; for the equilibrium is not strictly between one hundred pounds and twenty-five pounds moving (or disposed to move) four times as fast as the one hundred pounds.

A power of ten pounds moving with ten times the velocity of one hundred pounds would have equalled the one hundred in the same manner; and the same may be said of all the possible products equal to one hundred: but there must still be one hundred pounds of power on each side, whatever way they may be taken, whether in matter or in velocity.

This is an inviolable law of nature; by which nothing is left to art, but the choice of the several combinations that may produce the same effects.

The only interest that we can take in the projects which have been tried for procuring a perpetual motion, must arise from the opportunity that they afford of observing the weakness of human reason.

For a better instance of this can scarcely be supplied than to see a man spending whole years in the pursuit of an object, which a single week's application to sober philosophy would have convinced him was unattainable.

But for the satisfaction of those who may not be convinced

* The foregoing is an epitome of what has appeared, first in most of the German, and from them copied into English Encyclopædias.

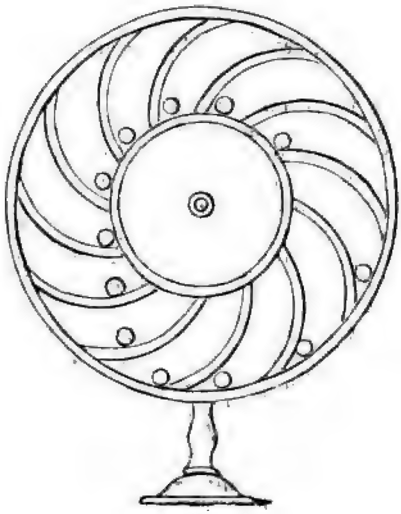
of the impossibility of attaining this grand object, we shall add a few observations on the subject of a still more practical nature than the above.

The most satisfactory confutation of the notion of the possibility of a perpetual motion is derived from the consideration of the properties of the centre of gravity; it is only necessary to examine whether it will begin to descend or ascend when the machine moves, or whether it will remain at rest. If it be so placed that it must either remain at rest or ascend, it is clear, from the laws of equilibrium, that no motion derived from gravitation can take place: if it may descend, it must either continue to descend for ever with a finite velocity, which is impossible, or it must first descend and then ascend with a vibratory motion, and then the case will be reducible to that of a pendulum, where it is obvious that no new motion is generated, and that the friction and resistance of the air must soon destroy the original motion.

One of the most common fallacies by which the superficial projectors of machines for obtaining a perpetual motion have been deluded, has arisen from imagining that any number of weights ascending by a certain path on one side of the centre of motion*, and descending on the other at a greater distance, must cause a constant preponderance on the side of the descent; and for this purpose weights have been made to slide or roll along grooves or planes, which lead them to a

* On this important point, the reader will do well to consult Bishop Wilkins, on the relation between the parts of a wheel and those of a balance, Chapter I., page 9 to 12; likewise Desaguliers's account of a compound balance, on which two bodies of equal weight may be variously suspended with respect to the centre, without losing their equilibrium, Chapter IV., pages 93 to 97; also noticed by Nicholson at page 79. At the conclusion of the Introductory Essay, the author has described the diagram of a model of his invention, perhaps still more convincing, as it forms an actual wheel, the rotation of which occasions all the weights on one side to protrude, yet without overbalancing; and, curious enough, on reversing the rotation the advanced weights all recede, and those nearest the centre are projected further from the centre, with no better result. No mechanic who has made himself acquainted with even these few facts, will feel justified in making models for plans of self-motive machinery, until he has first satisfied himself, by drawings made to scale, that the invention will bear the test of rigorous examination.

more remote part of the wheel, from whence they return as they ascend, as represented in the following figure*:—



Or they have been fixed on hinges, which allow them to fall over at a certain point, so as to become more distant from the centre; but it will appear, on the inspection of such a machine, that although some of the weights are more distant from the centre than others, yet there is always a proportionally smaller number of them on that side on which they have the greater power; so that these circumstances precisely counterbalance each other.

We have heard it proposed to attach hollow arms to a wheel by joints or hinges at the circumference, and to fill these arms with quicksilver or small balls instead of the plan represented by the above figure; but though we have never heard of it having been tried, we are perfectly convinced that

* In the model, the balls may be kept in their placcs by a plate of glass covering the wheel.

it would end as all other attempts have done; that is, in a total failure.—[" The Artisan; or, Mechanic's Instructor." 2 vols., 8vo. London, 1824-5.]

A Scotch journal gives the following popular view of the subject:—

It is not many years since the discovery of the perpetual motion was a subject of grave discussion, and numerous individuals of high ingenuity wasted their time, and exhausted their means, in futile contrivances destined to realize a notion which nobody had shown to be impossible. A more general diffusion of sound knowledge has of late thrown popular discredit on pursuits of this chimerical nature, and replaced the delusions which occupied minds of an inventive turn, by projects of a more rational character. Still, however, the subject is now and again revived, by some young mechanical novices, who for a short period of their noviciate imagine themselves endowed with a higher degree of inventive genius, than ever before fell to the lot of any single contriver. A young man in the first year of his apprenticeship, struck with the beauty of the machinery which he sees around him, and as yet but ill-acquainted with the principles of its construction, and having heard a deal about a perpetual motion, begins to plan, and lights upon a project which he feels sure could not have been before thought of, and it must succeed. Many a sleepless hour it costs him, and it is only after a salutary exhibition of the absurdity of his scheme to astonish the world by his powers of invention, that he is cured of his self-idolatry.

It may not be difficult to see why the particular contrivance failed in producing the expected effect; but it is not therefore manifest that all contrivances would similarly fail, or that the problem is practically impossible; and, supposing the novice after his failure were to inquire at some of his own experienced acquaintances—some one, perhaps, whom he has heard ridiculing the notion in the strongest terms, as grossly absurd—would he receive a convincing statement of the insurmountable difficulty? Put the question broadly—why is a perpetual motion, in the sense in which mechanics understand it, impossible? It is not enough to say that great and

numerous attempts have been made to attain it, and all without success; for the question just occurs—why did they fail? If they failed for want of ingenuity, then a perpetual motion is possible; but that is denied,—then wherein consists the cause of failure?

It is in this way that we may suppose the experienced derider of perpetual motions to be "pushed home" by his young experimenting friend, and he will require some knowledge of mechanical principles to escape without humiliation. The attempt is not always successful: we have been witness to more than one case, in which the strength of the argument lay on the wrong side. We have even met with instances, where, at the same time that the notion of a perpetual motion was ridiculed in unqualified terms, exactly the same absurdity was admitted indirectly, as one of the most easy and practical things which could be imagined. As a palpable case, we have heard a gentleman of veracity state, and maintain the statement, that he had observed in the course of his travels, which were not very extensive, an apparatus, consisting of an overshot wheel and pump, for clearing a quarry of bed-water; and that the wheel was driven by a portion of the same water which the pump lifted. Now this is the very beau ideal of a perpetual motion. Here was a pump capable of lifting more water than was required to work it; consequently, the superfluous water, being so much extra power, might have been applied to do other work, as lifting stones and the like. And farther, the same apparatus might be erected over a tank of water, and it would work on so long as the machinery remained in good repair, and the power which it furnished after driving itself might be applied to any useful purpose. But what are the real facts of the case? Supposing the machinery once fairly set in motion, and supposing that its motion was retarded by no friction or other resisting cause, and that there was no waste of water by leakage, then would it continue to work for an indefinite time,—the pump would go on, lifting the water to the height from which it descended upon the wheel, but not the millioneth part of an inch higher.

In fact, as the pump obviously can give no power, the whole apparatus might be viewed as a single water-wheel, in which the ascending side received at the bottom, and carried up with it just as much water as the descending side received

at the top to carry down; and in such an arrangement, it is manifestly of no consequence whether the water ever leaves the wheel or not; that is, whether it be thrown off by the descending buckets at the bottom, and taken in by the ascending buckets at the same point, or be simply carried round with the revolutions of the wheel without displacement from the buckets into which it was first poured. And if this be true, it is not very difficult to see that the wheel would move *ad infinitum*, just as well without the water at all! Now, the real circumstances are these:—The effective power of the best-constructed overshot water-wheel is only 70 per cent. of the power which drives it; that is, for every 100 gallons of water expended upon driving it, it would lift 70 gallons to the same height, and no more; and a pumping apparatus must be very well constructed indeed, to give an actual result equal to 70 per cent. of the power of the wheel. Here, then, is a loss of 30 per cent. of power in working the apparatus, and, consequently, all the water lifted by the pump would just be half sufficient to keep up the motion, without requiring the machinery to do any other work. So much, then, for not knowing how to observe.

The case which we have here noticed is probably absurd to every mechanic who knows anything about hydraulic machines; but the same absurdity has sometimes been scarcely less glaringly introduced into the schemes of ignorant projectors. Many of these worthies, in the plenitude of their presumption, undertake to create power by complex combinations of mechanical elements which they obviously do not understand. Within perhaps 200 yards of where we write, still stands, for aught we know to the contrary, a specimen of this sort, on which we believe not less than £1,000, were spent, and which was not patented only in consequence of the death of the projector. The money belonged to a person who, fortunately, can sustain the loss of it without serious inconvenience, and who perhaps deserved to pay the penalty of his ignorance; the merit of the contrivance belonged to one of those individuals who would rather scheme than work, and who had just that amount of mechanical knowledge which is dangerous. The machine alluded to is likewise an hydraulic one, and its pretended object was to save three-fourths of the water used, by pumping it up again to the top of the fall, and this without loss of

effective power in the machine! This person, and his employer, no doubt laughed loudly together at the absurdity of a perpetual motion.

But all the great projectors of this class are not simply water doctors. We have known them take to contrivances for "lifting great weights without loss of speed," and find their multiplicity of pulleys, wheels, and pinions, bent and straight levers, all resolvable into a value little superior to that of a single pulley. This is fact; we have seen such a combination of mechanical elements, and for such an object, on which a man—a great genius in his own and his employer's estimation—worked for upwards of two years with bolted doors, and every other precaution against the mighty secret being divulged to the wondering world.—["The Practical Mechanic and Engineer's Magazine," vol. 1, Glasgow, 1841, pp. 8-12.]

The following paper gives "An Account of Three Large Loadstones, one of which presented an unusual Line of Attraction. By John Deuchar, M.W.S., and Lecturer on Chemistry in Edinburgh. Read before the Wernerian Natural History Society, March 10, 1821."

After a few introductory remarks, he says:—"The largest of the loadstones, independent of its armature and connecting iron, weighs 125¼ pounds, and it measures

In length	10¾ inches
In breadth	8½ „
In height	9½ „

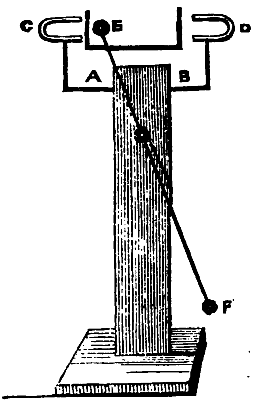
and was capable in all of bearing a weight of 205 pounds." He then proceeds to a description of the two others, and observes:—

Before concluding this paper, I may take notice of an imposition which was, about three years ago, attempted to be kept up upon the prosecutors of science in different parts of the united kingdom by a needy shoemaker, of the name of Spence,* as this disgraceful fraud was first exposed by means of the largest of the magnets just explained. This individual pre-

* See further notices of him in pages 180 and 226.

tended to have discovered a black substance which did not conduct magnetic energy through it, and he wished it to appear that when this substance was made to come between a steel beam and a magnet, the power of attraction was lessened, if not altogether stopped. He placed machinery in such a situation as not to be observed; and, with the assistance of a few falsehoods, which he found very useful in raising the curiosity and extorting the charity of credulous visitors, he tried to induce a belief that a pendulum was then moving a clock, and had continued to do so for six months, without any other exciting power than two small magnets. This is shewn in Fig. 9. A B are two supposed non-conductors of

(*Fig.* 9.)



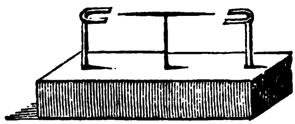
(The pretended Pendulum Motion by Magnetism.)

magnetism, affixed to the opposite ends of a beam moving on its centre; C D are the two magnets, which were said to attract alternately the end E of the pendulum E F. At the commencement of the motion of the pendulum, it was said that one of the pieces of the black substance, say A, was moved from between the magnet C and the pendulum; this enabled the attraction between C E to take place, and cut off the attraction between D E; and this is the state in which the figure on the plate is drawn. But as E approaches nearer

to C, so as to prevent the actual contact of C E, then A moves up, and entirely cuts off the effect, and at the same time B leaves the power of D in full action; therefore E moves from C towards D, and, when it has nearly arrived there, B again moves up, and A descends: and thus, it was maintained, the continued motion of the pendulum was kept up.

Another way of exhibiting this deception is shown in Fig. 10. Here, by the false account given, we are told that a very fine steel beam, about an inch in length, has been made

(*Fig.* 10.)

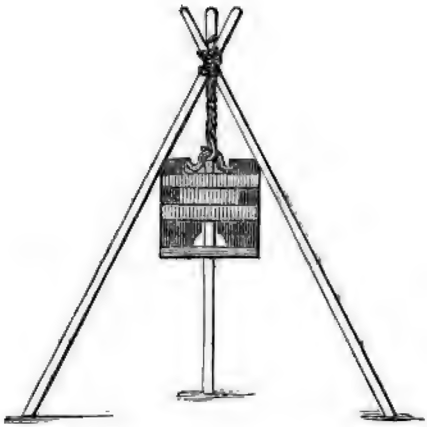


(The pretended Perpetual Magnetic Motion.)

to revolve with great rapidity for many months, and that two magnets, partially coated with the extraordinary black substance already noticed, and placed at opposite sides, are the sole cause of the motion. This motion, it is almost unnecessary to add, was also induced by secreted machinery in the box on which it rested. On one of the nights of lecture, when I was upon the subject of magnetism, this scientific juggler brought his perpetual motion, as he called it, to the class-room. As at this time I had the largest of the three magnets (Fig. 11) suspended there, for the purpose of explaining its peculiarities and powers, I thought it would be a good opportunity to try the truth of his assertion with regard to the cause of the motion. I therefore placed the revolving needle (Fig. 10) on a table under the large magnet, while the usual weight which it carried was removed, but the needle moved as rapidly as before. Here, then, a loadstone capable of lifting 205 pounds did not affect a needle said to be moved by two very small artificial horse-shoe magnets. On another occasion I placed a piece of the black substance, which was called a non-conductor, between a magnet and a magnetised sewing-needle, which I balanced on the point of my finger, and I found it to be attracted and repelled, as

the different poles were presented, in the same way as if no such black substance had intervened,—[" The Glasgow Mechanics' Magazine," vol. 2, 1824-5, p. 98.

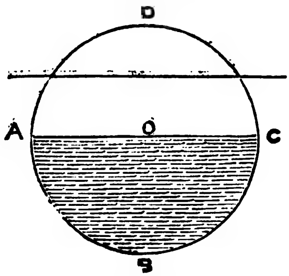
(*Fig.* 11.)



(Dr. Hope's large Magnet, as it was suspended in Mr. Deuchar's class-room.)

PERPETUAL MOTION; A PARADOX.—Let A B C D, Fig. 7,

(*Fig.* 7.)

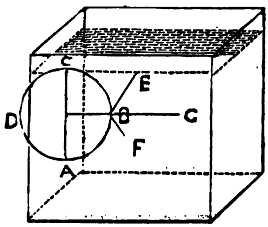


be a wheel moveable on its axis, passing through its centre O; if one half of it, A B C, be situated in a vessel filled with

water, and the other half A D C lose as much of its weight as the weight of its bulk of water, will it occasion A D C to preponderate and produce a constant motion; or does the wheel remain in equilibrium, and if so, what is the occasion of this paradox?—[Vol. 2, 1824-5, p. 42.]

EXPLANATION OF THE FOREGOING PARADOX.—The pressure of the water in every direction at any point B, Fig. 2, being equal, if E B and F B be the directions of two of these pressures equally inclined to the radius produced, O B G, then their resultant is G B O, in the direction of the centre; which can, therefore, have no tendency to put the wheel in motion. The same may be said of every two similar pressures, hence the wheel remains in equilibrium.—[Vol. 2, p. 42.]

(*Fig.* 2.)



A PERPETUAL MOTION PUMP.—A correspondent of the "Glasgow Mechanics' Magazine" thus describes his views:—

I thought I had discovered the perpetual motion. The method which appeared to me likely to answer was this:—Place a wheel in a large cistern, so that it may turn round without touching the water at the bottom, and that the water falling upon the wheel may not escape from the cistern. Attach this wheel to the end of a beam, or balance, by a crank; to the other end of this balance attach a pump, or pumps, to raise a sufficient quantity of water from the cistern to drive the wheel; raise this water into another cistern about double the height of the wheel; below this cistern place another, containing a wheel of the same size, and in the same situation as the former. The water in the highest cistern would turn this wheel, and the water in the middle cistern would drive the first-mentioned wheel (being lower than the other). You will observe, the intention of the higher wheel is to drive

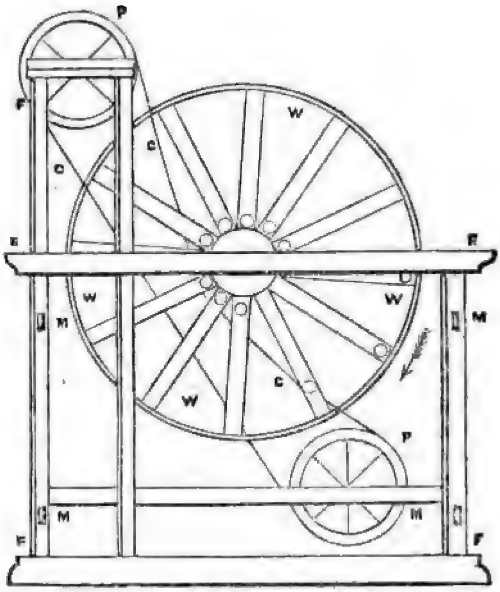
machinery, as the power of the lower one is exhausted (or, as I afterwards understood, overcome) by working the pumps.—[Vol. 2, p. 219.]

A Perpetual Motion by Hollow-spoked Wheel and Balls; thus described:—

The annexed drawing shows how I have at length taken this enticing jilt (perpetual motion), though after a long and weary chase—

> Through pleasant and delightful fields,
> Through barren tracts and lonely wilds;
> 'Mongst quagmires, mosses, muirs, and marshes,
> Where deil or spunkie never scarce is!
> By chance I happened on her den,
> And took her when she didna ken.

(*Fig.* 3.)



W W W W (Fig. 3) represents a wheel with twelve hollow spokes, in each of which there is a rolling weight or

ball. C C C C is a chain passing over two pulleys P P. There is an opening round the wheel from the nave to the circumference, so as to allow the chain to pass freely and to meet the weights. The weights are met by the chain as the wheel revolves, and are raised from the circumference till they are at last brought close to the nave, where they remain till, by the revolution of the wheel, they are allowed to roll out to the circumference. By this arrangement, the weights are, on one side of the wheel, always at the circumference, so that that side is more powerful than the other, which causes the wheel continually to revolve. F F F F is the frame of the machine; M M M M the mortices for joining the two sides of the frame by cross rails. The arrows point out the direction in which the wheel turns.—I am, yours, &c., DIXON VALLANCE. Liberton, Lanarkshire, Nov. 10, 1825. —[Vol. 4, p. 227.]

He afterwards writes to suggest employing angled spokes, which allow the rolling weights to run off above the centre. In this machine the angle between the chain and the spokes is less acute than in the other, which has spokes straight out from the centre, and of course it has more power; the wheel with 12 hollow spokes having an opening in them to allow the chain to pass freely, and to meet the weights, with the chain passing over two pulleys.

[Our friend, Mr. Vallance, is probably not aware that machines on the same principle with the above have been repeatedly tried, and as often found to fail. Indeed, until he can remove the effects of friction, he will not get this amended machine to move any time. It is not to be disputed, that the friction of the rollers or the chain, and the wheel itself, will completely compensate any power derived from the weight which the descending balls may have over the ascending.—EDS. "The Glasgow Mechanics' Magazine," vol. 5, 1826, p. 166.]

PERPETUAL MOTION: its Pursuit Censured.—In the "Saturday Magazine," for 1838, appears an article on

"Recreations in Natural Philosophy:" the fifth part is "On Perpetual Motion," from which the following is an extract:—

An amusing, but at the same time a melancholy and instructive, history might be formed of the various visionary schemes which, in all ages, have disposed some enthusiastic men to dissipate their time and fortune in seeking to obtain some object which should either confer boundless riches on its possessor, or shield him from all the ordinary accidents of life.

Our distinguished countryman, Dr. Thomas Young, says that "to seek for a source of motion in the construction of a machine betrays a gross ignorance of the principles on which all machines operate. The only interest that we can take in the projects which have been tried for procuring a perpetual motion, must arise from the opportunity afforded us to observe the weakness of human reason; to see a man spending whole years in the pursuit of an object which a week's application to sober philosophy might have convinced him was unattainable."

It will be amusing to adduce a few examples of this "gross ignorance," in some out of the numerous attempts which have been made to obtain perpetual motion.

[These consist of three plans of wheels with moving weights, and a self-filling goblet,—this last from Dr. Arnott's work,—all occurring in the present treatise.]

A few years ago, a person fond of mechanical pursuits submitted to the writer a plan for a machine whose object was to supersede the steam-engine. Water was the moving power, and the principle was somewhat similar to that of the hydrostatic press. He said his invention, being new, could not be affected by anything that had been written on the subject. He contrived many arrangements and spent much money, without the smallest prospect of a proportionate return from it.—[Vol. 13, p. 99.]

On a Plan of Perpetual Motion at Ferrara, we find the following in an Italian Journal:—

Signor Alfonzo Roito, of Ferrara, has made several experiments, by which he believes to have discovered perpetual mo-

tion. His invention does not appear to deserve to be put on one side like many others, for the Government has taken it seriously into consideration. The Cardinal Ilgolini, legate at Ferrara, has nominated a committee of competent judges—philosophers, engineers, and mechanics—for the purpose of testing its merits. The committee has already sat twice, and reports and drawings have been sent to Rome, to the Government, with the following recommendation by the committee :—

First. After having carefully examined the forces which act on the machine, and having as nearly as possible tested their power, always to the disadvantage of the machine, we find that the forces *favourable* to the motion are superior to those which are against it. The resistance of the parts which compose the machine appear to us to possess all the requisite strength; consequently, our opinion is, that it is *very likely* that the machine may be put in motion by itself, and that it will not easily be deranged.

Secondly. Your committee finds that the construction of the machine is ingenious and simple; and after having examined the machine as to the mode in which its movements are brought to act together, your committee considers it worthy of high praise.

Thirdly. The expenses of the construction will not exceed 1,500 Roman crowns, 8,070 francs,—a small outlay if the advantages gained shall be such as the inventor anticipates; among others, of setting in action four pair of stones for grinding wheat.—["The Inventors' Advocate, and Patentees' Recorder," 4to., 1839, vol. 1, p. 183.]

THE ATTEMPTS TO PRODUCE A PERPETUAL MOTION.—In a leading article of the "Inventors' Advocate," the Editor says :—

There are few objects on which so much time and money have been thrown away as in the fruitless attempts to construct a machine that will move for ever. Patent after patent has been taken out with a view to secure the exclusive right to inventions in which it was falsely imagined the desired object had been attained. A description of all the inventions for the purpose of procuring perpetual motion would, indeed, present a curious record of ignorance, fallacious reasoning, and misdirected ingenuity.

[After some general remarks he adds:—]

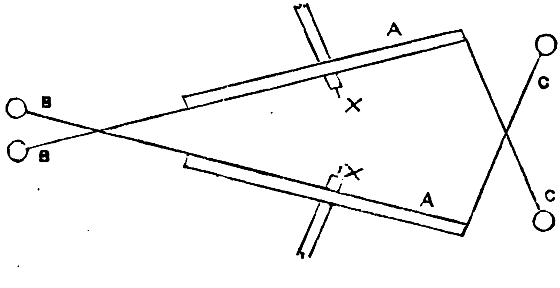
It has been frequently attempted to apply the power of gravitation for this purpose; but as that power acts equally on the whole mass of matter in the earth, its force cannot be varied, nor its direction changed, by any means within the limits of human capability.—[Vol 9, 1840, p. 264.]

ALLEGED DISCOVERY BY GEORGE WATHER.—In the "Engineer," February 8, 1856, is copy of a police report, in which is an account of the difficulties of George Wather, tailor, about 70 years of age, from Bridport, who applied for advice. About four years ago (1852) he ventured on marrying a third time, and carried on business in a small way, until he by accident discovered that which had for centuries baffled the greatest philosophers, namely, the "perpetual motion." His friends said that doubtless he would meet with distinguished patrons in London. Encouraged by their representations, he and his wife set off with just sufficient to bring them to town. His impression was that he should be possessed of thousands in a few days, but, to his utter astonishment, neither the authorities at Marlborough House, the Lord Chancellor, nor Lord Palmerston, would entertain his invaluable discovery, nor, in fact, could he find any one who would; thus he was left destitute, without means to get back to Bridport. He was relieved from the poor-box, and obtained a pass home. [Vol. 1, 1856, p. 73.]

AN AMERICAN PLAN OF PERPETUAL MOTION:—

Even the pursuit after perpetual motion, hopeless as it is,

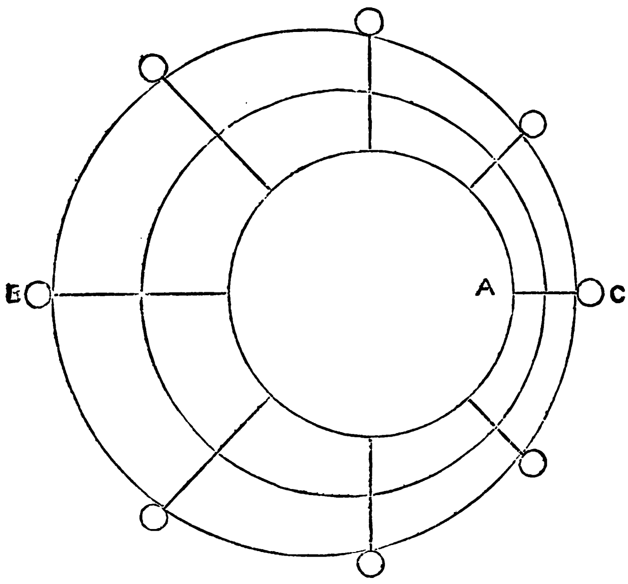
(*Fig.* 1.)



may not be considered entirely vain, in occasionally leading to useful modifications of machinery. As an instance of this, I here submit to you a plan suggested by an ingenious friend of mine, several years ago, as in the diagrams annexed, Fig. 1, a perpendicular, and Fig. 2 a horizontal view.

A A, two vertical wheels, placed diagonally, and revolving on the axes X X. The levers B B and C C are hinged at the peripheries of the wheels. By rotation the arms B B are projected from the centre of motion, while the arms C C are drawn in.

(*Fig.* 2.)



It is plain that a series of arms as shown in Fig. 2, will produce an eccentric motion, causing the weights at their ends apparently to preponderate on the side B.—BELIDOR.—["The Journal of the Franklin Institute." Philadelphia, 1828. Vol. 6, p. 414.]

WILLIS'S PERPETUAL MOTION.—A Public Exhibition.— The following is abridged from the "Scientific American:"—

One of the immutable laws of dynamics is, that all bodies when once set in motion will continue their movements until stopped by some opposing force. The only known opponents to continued motion are friction, gravity, and resistance of the air.

Many attempts have been made during the last three centuries to evade the dynamic law first mentioned. We could fill many pages with descriptions of pretended perpetual motion machines, some of them very curious, if it were necessary; let it suffice to refer to Austin's self-moving machine (page 209, vol. 2), and another on page 267, as specimens of what has been done.

One of the latest attempts at perpetual motion is that of Mr. E. P. Willis, first put on exhibition at New Haven, Conn., and lately at New York (1856). It is heralded to the public through advertisements and placards, as "the greatest discovery ever yet made."

[An engraving is given of the machine, as seen in a glass case, and the Editor having seen it at work, adds:—]

This machine is very beautifully constructed. The shaft bearings are fine steel points, and have but little friction. Possibly it is one of those contrivances that will run for a few hours without stopping, owing to nice adjustment and the trifling amount of friction; we are inclined to think, however, that it is driven by electro-magnetism, or some other concealed power.

The ideal water-wheel, to work a pump and lift water enough to keep the wheel always moving, is planned on the same principle.

No one is allowed to examine, and they say in their placards "Why it is not a *bona fide* 'perpetual motion' is left for the curious on the subject to determine."—[Vol. 11, 1856, p. 201.]

ANOTHER AMERICAN PERPETUAL MOTION.—In our remarks (says the Editor) relative to Willis' "perpetual motion," we referred to an ideal water-wheel intended to keep itself in constant motion.

We are in the frequent receipt of letters containing sketches of devices arranged on similar principles, and asking our advice relative to the proper steps necessary to be taken in order to secure such valuable discoveries. We have received from an inventor in Virginia a sketch of one of the before-named water-wheels, and he wants to hear from us "as soon as possible."

Another correspondent describes a plan that was "suggested by a dream," but "it stopped" after every push.—[Vol. 11, 1856, p. 232.]

In Poppe's "Taschenbuch für Urhmacher, &c.," 1822, relating to Clock and Watchwork generally, is an "Appendix, on Perpetual Motion," a large portion of which referring to the imposition practised by Geiser, applications of Galvanic agency, and some descriptions previously given in the present work, are, therefore, either omitted in consequence, or much abridged.

Meaning by perpetual motion a machine whose motion is constantly renewed by the means of its own mechanism, and uninterruptedly maintained without any fresh impulse, the discovery of such a motion is difficult but not impossible; as Kästner, Langsdorf, and other celebrated mathematicians have frequently shown.

For several hundred years some of the best mechanics have given themselves endless trouble and pains to discover this motion without success. Many have had plans they thought would solve the problem, but after a short time have ceased or required repair. Balls have been made to run uninterruptedly in channels for a certain time, smalls clocks moved by atmospheric influence have been brought forward, so was Cox's barometer, also Recorder's cleverly-constructed pocket-watch, worked by a hidden weight, and numerous other contrivances of this kind, have all failed to deserve their claimed reputation.

The wonderful and cleverly-worked pendulum clock of Geiser, of Chaux de Fond, which was recognised and admired by many of the best-informed men of the day, proved a deception as a perpetual movement. When thoroughly examined inwardly and outwardly, some time after his death, it was found that the centre props supporting its cylinders

contained cleverly-constructed, hidden clock-work, wound up by inserting a key in a small hole under the second hand.

Of all the contrivances to produce perpetual motion yet brought to light—Zamboni's pile, and Ramis's electric pendulum clocks seem most deserving of the name.*

PERPETUAL MOTION: AN ABSURD PRETENSION.—Lewis C. Buck, M.D., Professor of Chemistry in the University of the City of New York, &c., in his "Researches on Commercial Potash," after giving the specification of a patent for a most absurd mode of manufacturing potash, and which by the specious pretensions of the patentee, imposed on many, takes the opportunity to observe in a note, as follows:—

It need not excite surprise that such nonsense should gain currency among ignorant manufacturers, when intelligent and even scientific men often countenance the most absurd pretensions. I once saw the names of several respectable gentlemen, and, among the rest, that of a professor in one of our colleges, attached to a certificate in favour of a perpetual motion, which the inventor had the folly to exhibit.—["The American Journal of Science and Arts," conducted by Benjamin Silliman, M.D., LL.D., vol. 29, 1836, p. 262.

* Dr. J. H. M. Poppe Die Wand, Stand und Taschenuhren; der mechanismus, die Erhaltung, Reparatur, und Stellung derselben; Taschenbuch fur Urmacher, &c. Frankfurt am Main, 1822, 12mo., p. 176.

CHAPTER X.

NEWSPAPERS AND MISCELLANEOUS SOURCES OF INFORMATION.

As may be supposed, articles from the public press refer generally to announcements of the supposed practical solution of the problem; and we have here an addition to the British and foreign claimants already cited. To these are added the views of Pasley, from his eccentric work on Natural Philosophy; four unpublished schemes; instances of imposture; and the particulars of a Joint-stock Perpetual Motion Company.

We shall commence this chapter with an apposite quotation from that ancient book of "Notes and Queries"—"The Athenian Oracle," which inquires and replies as follows:—

QUEST. 5. Why may there not be invented a perpetua motion?

ANSW. Archimedes, that indefatigable inquirer into mathematical speculation, having this question proposed unto him, viz., Whether he could move the globe of this world, he made this answer, That if the proposer could find another basis to fix the foot of his engine upon, he would undertake to remove it. In like manner, we say, Find us bodies or matter that are qualified for a perpetual motion, and we'll undertake the affirmative of the question. But if, upon a particular search of every individual particle of the creation, we find nothing but what is subject to change—not by flux of time, for time destroys nothing, but by motion and antipathies in nature—then it follows that the impossibility of perpetual duration necessitates the impossibility of a perpetual motion.*—["The Athenian Mercury," No. 7, April, 1691.]

* The History of the Athenian Society, for the resolving of all nice and curious questions. Printed for James Dowley (1690-3), folio.

Also, The Athenian Oracle, being an entire collection of all the valuable questions and answers in the old Athenian Mercuries. 3 vols., 8vo., 1704. (See vol. 1, p. 18.)

ALLEGED DISCOVERY OF PERPETUAL MOTION by Lewis Bayne, and Account of John Spence's Invention; from an Inverness paper.

We have much pleasure in being enabled to announce to the public that Mr. Lewis Bayne, officer of excise, in this place, two years ago constructed a perpetually-moving time-piece, which, we are informed, measures time with the greatest exactness. This machine is kept in motion by means of magnetic attraction; but in the construction of it Mr. Bayne makes use of but one magnet. It is only about six months since this ingenious time-piece was shewn to us; but there are several inhabitants of this place who have seen it going these two years past. The inventor has often been requested to announce his invention to the public, but it is only now that he has consented to do so. He is about to construct one on a small scale, to stand on a table or chimney-piece. The principle upon which this machine is constructed is very simple, and the expense at which it could be made, we think, would be considerably less than that of an ordinary clock. It is but fair to state that, in the pursuit of his mechanical inventions, Mr. Bayne found it both expensive and troublesome to procure the brass wheel, &c., of which he stood in need. He therefore, a considerable time ago, set himself to make a machine for cutting his own wheels, and succeeded in this also. In the "Edinburgh Magazine" for May, 1818, we have an account of the invention of a perpetual motion, by John Spence,* of Linlithgow, by means of two magnets. But independently of Mr. Bayne's invention being first in point of time (for we have no reason to believe that the invention of the ingenious mechanic of Linlithgow is a twelvemonth old), it is certainly also first in point of importance.

The invention of John Spence consists merely of a wooden beam, poised by the centre, which has a piece of steel attached to one end of it, that is alternately drawn up by a magnet placed above it, and down by another placed below it. As the end of the beam approaches the magnet, hither above or below, the machine interjects a non-conducting substance, which suspends the attraction of the magnet

* See also pages 180 and 226.

approached, and allows the other to exert its powers. Thus the end of the beam continually ascends and descends betwixt the two magnets, without ever coming into contact with either; the attractive power of each being suspended precisely at the moment of nearest approach.—[" The Kaleidoscope." Liverpool, Nov., 1818. Vol. 1, p. 67.]

JOHN DALLING'S PERPETUAL MOTION.—The following letter on this subject has been addressed to the Editor of the " Dumfries and Glasgow Courier:"—

Sir,—Having been informed that the Board of Longitude has offered a great reward to any person who should produce a machine so constructed as to preserve a perpetual motion without the aid of weight or spring, and being stimulated by the hope of such reward, I set my invention to work, and have now discovered one which, I hope, will meet with approbation. It will revolve without the aid of wind, water, weight, steam, spring, lever, or attraction. It will keep uniform motion as long as the materials of which it is made will last, which may be of wood, or any metal. It will revolve vertically, horizontally, or at any angle of inclination. It is the same on water as on land. The motion of a ship makes no variation upon it, neither is it affected by heat or cold. Its principle may be applied to a watch or clock, and made to drive any sort of machinery. It is not dependent upon any power yet known to the world, and its principle is as endless as the periphery of a circle. The above are a few, but a very few, of the qualities of which it is possessed, and of the uses to which it may be applied; and I trust its own intrinsic worth, when known, will be sufficient to advocate its cause. I have no patron to introduce me to public notice, but propose humbly to lay my claim at the feet of his Royal Highness the Duke of Clarence, who presides at the Honourable Board of Longitude; and, if it is found by them to possess the requisite qualities for nautical purposes, superior to anything of which they are at present in possession, I think I may rely on their justice and liberality for a suitable recompense. When my secret is brought to light, it will astonish the most learned of the present day. It will elevate the honour

of this country, and will incalculably augment its wealth and resources. By giving the above a place in your patriotic paper, you will oblige, Sir, your obedient humble servant, JOHN DALLING, Joiner, Castle Douglas.—["The Liverpool Mercury," October, 1813, vol. 3, p. 134.]

WAGER IN REFERENCE TO REDHŒFFER'S PERPETUAL MOTION, ALLEGED TO BE AN IMPOSTURE.*—The following wager appears in the "Philadelphia Gazette:"—

I hereby offer, on demand, any bet or bets from 6,000 to 100,000 dollars, to the end of proving, in a few days, both by mathematical data and three several experiments, to the satisfaction of enlightened judges, chosen by my very opponents out of the most respectable gentlemen of this city, or of New York, that Mr. Redhœffer's discovery is genuine, and that it is incontestibly such a perpetual self-moving principle as the one alluded to by Sir Isaac Newton, in his "Principia Mathematica," b. 1, sec. 13, on the Laws of Motion.

N.B. This is to be valid until the 15th inst., at sun-setting.

CHARLES GOBERT, Civil Engineer, &c. Philadelphia, July 12th, 1813.—["The Liverpool Mercury," October, 1813, vol. 3, p. 134.]

MANNARDET'S PERPETUAL MOTION.—A French mechanic at Neufchatel, named Mannardet, is said to have discovered the *perpetuum mobile.* It consists of a wheel, on the periphery of which are small pipes half filled with quicksilver, which, at the top, have a centrifugal direction, and by a simple contrivance receive below an opposite impulse. He shows the machine publicly, and intends to submit the solution of this difficult problem to a further examination at Paris. The simplicity of the construction occasions a favourable opinion of the thing.—["The Liverpool Mercury," October, 1815, vol. 5, p. 110.]

GARHAR'S PERPETUAL MOTION.—A. M. Raymond Vincent Ignan Garhar, of Frankfort, it is pretended, has

* See statement made at page 222.

invented a wheel, the movement of which is perpetual and spontaneous. The Emperor of Austria has granted him an exclusive privilege for fifteen years, if within a year he brings his invention into use.—["The Liverpool Mercury," May, 1816, vol. 5, p. 358.]

GEYSER'S PERPETUAL MOTION.*—M. M. Geyser, canton of Berne, Switzerland, residing at La Chaux-de-Fonds, has exhibited to the Genevese Society for the Advancement of Arts, a wheel which seems to turn of itself, and of which the most skilful artists cannot discover the moving principle, which the artist keeps a secret. The Society admire the execution of the machine, and acknowledge that the effect is very striking. Probably it is on a principle already announced, which applies, as a moving power, the elasticity of the atmospheric air to an exhausted cavity which is made to turn out of the centre of the mass by uniform pressure. —["The Liverpool Mercury," October, 1816, vol. 6, p. 107.]

AN ADVERTISED PERPETUAL MOTION.—The following curious advertisement is from a late "Dublin Evening Post." Whatever ingenuity may be in the mechanical part of the invention, we are particularly struck with the modesty of the projector, in contenting himself with so moderate a payment in advance:—

PERPETUAL MOTION.—Take notice, that I will exhibit, after six days' notice, for the sum of £300,000, that long-wished-for perpetual motion, now going in its rapid velocity, without the aid or assistance of man or beast, springs, weights, or balances, steam, wind, or water, or any other visible assistance, and will continue in its rapid velocity as long as a body of any substance lasts.

Let the reader not doubt my undertaking, as I will undergo any penalty requested of me to exhibit an art which no second mortal can effect by study or ingenuity. Now, all gentlemen who study the merit and honour of

* Declared an imposition, see page 183, and end of this chapter.

their country, let them appeal to me, and I will, for the above sum, exhibit an art that will be a honour to Ireland until the expiration of time.

An art that had heretofore defeated the great Sir Isaac Newton, after many years' study; likewise the known world. This art I have effected at my first trial of it, on a small scale, with a few minutes' study and three hours' labour.

An art that no second mortal can effect, I now challenge the known world; I dare their study or ingenuity to execute what I have done. Should this undertaking be left unnoticed, I will sell its merits to another country.—["The Liverpool Mercury," August, 1817, vol. 7, p. 62.]

ALLEGED DISCOVERY OF PERPETUAL MOTION.—What a proud day for the "Mercury" to have to announce the discovery of the perpetual motion, which has baffled so many wiseacres and ruined so many speculative mechanists. What a credit to the country, too, that this "consummation, so devoutly to be wished for," should have proceeded from an inhabitant of Toxteth Park. The modesty of the projector is only surpassed by his genius, or he would never have concealed his name from a wondering and an enquiring world. The following bulletin, on this great occasion, is given *verbatim et literatim* as we received it from the author:—"Gentlemen Please to Publish in Your paper that I Can produce an instrument that will Give true time by Real Perpetual Motion it is no use for Me to praise My Works for the Works and Move Movements will prove and praise them Selves and the Latitude Can be found out by the same instrument—it is found out by J..n A......n a Resident in in Toxteth Park Near St. James."—["The Liverpool Mercury," October, 1817, vol. 7, p. 120.]

PERPETUAL MOTION BY A MECHANIC AT NEWCASTLE.—An ingenious mechanic, of Newcastle, has discovered a new and simple power, which he conceives involves the desideratum of perpetual motion, and which he purposes laying before the proper authorities appointed by Government.—["The Liverpool Mercury," 1821, vol. 10, p. 382.]

A Fictitious Perpetual Motion.—A correspondent, addressing the "Liverpool Mercury," says:—

The model now exhibiting in Lord-street, as a perpetual motion working by the "power of gravity," was, during the last spring, offered to the inhabitants of the metropolis, when, being detected by a celebrated American engineer, who had seen several of the kind in Philadelphia, some gentlemen posted a large placard at the door of the exhibition, cautioning the public against imposition, which soon induced the proprietor to decamp to places whose inhabitants he conceived more likely to be imposed on by his "powers of gravity."

Several of these articles have been prepared in America, the whole of which act by means of a concealed spring, either in the horizontal wheel itself, in the pedestal of the model, or by a helical one in either of the pillars. In the two latter modes of arranging it, the motion is communicated by means of a small watch wheel, concealed in the clumsy brass bridge through which the lower pivot of the upright shaft works, with its point resting upon a plate of glass.

I trust this communication may prevent the good people of Liverpool from being duped by one of the most glaring absurdities I ever witnessed.—["The Liverpool Mercury," August, 1822, vol. 12, p. 46.]

The Editor next week remarks on this Perpetual Motion:

We have to state that the manager of the wonderful perpetual motion decamped immediately after the appearance of the "Mercury" in which his trick was exposed.

Presumed Discovery of Perpetual Motion.—A correspondent, writing from Ormskirk, April, 1828, says:—

An ingenious neighbour of mine has been exercising his wits to find out the perpetual motion. He does not pretend to have achieved so great a desideratum, but he says he has found out a motion that will continue in action, or to move, as long as the material of which it is composed will

endure. It is applicable to watches, lathes, engines—steam engines, I had nearly said; but there will be no occasion for steam or gas either. Not being a mechanic myself, I find it a very difficult matter to state the man's ideas, and make them plain to the reader. He says he has mentioned the thing to several curious men, and even showed it in its rude state to many neighbours. They all agreed that it was a great discovery, and that it ought to be made public; but, though most of them are men of talent, they are not in the habit of writing for newspapers. It was, at last, agreed that he had better apply to your humble correspondent, who would, at all events, do something by describing his excellent invention, and thereby bring to his aid all the lovers of mechanism. His object is not money: he wishes to do something for the benefit of his fellow-men. He is an honest, industrious man, but he wants the means to put his machine in such order, perfection, &c., that it may easily be understood by the public. He says that, if any society or individual will enable him to put his discovery into a tangible shape, he will gladly share the profits with them, or throw the whole concern into their hands.—["The Liverpool Mercury," April, 1828, vol. 18, p. 107.]

Alleged Discovery of Perpetual Motion by M. Vandyke.—This long-sought-for discovery, it is said, has been brought to light by Mr. Vandyke, of Orleans county. The machine is so constructed, by means of tubes, as to produce a current of air that propels a wheel, and keeps it in continual motion. It is said that it may be converted to many valuable purposes.—*American Paper.*—["The Liverpool Mercury," July, 1829, vol. 19, p. 222.]

Richards' Endless Power Engine.—An engineer of Bristol, named Richards, living in that city, has, after fifteen years' study and labour, completed a machine, which he calls his "Endless Power Machine," which is now in motion. This engine, it is said, will supersede the use of steam in all its various purposes. The inventor declares that his self-acting engine of 250 horse power will take a vessel round the world

with the small quantity of two gallons of oil applied to its movements when required.—*Bath Herald.*—[" The Observer," London, July, 1831.]

M. DE VIGNERNON'S NEW MECHANICAL POWER; and English claim to the same.—In a letter addressed to the Editor of the "Morning Advertiser," inserted Dec. 5, 1851, the writer says:—

Will you have the goodness to do the reputation of England a piece of justice, which the "Times" (newspaper), never possessed of a particle of public spirit, omits to do.

Some few days ago that paper quoted from the "Courrier de la Garonne" a paragraph stating that a French engineer of Bordeaux, named De Vignernon, had obtained "from a quantity of water at rest, and confined in a certain space, a perpetual power that will supply the place of all other moving powers."

Now this was vague enough to the general reader, but the writer of this letter detected at once the identity of this French discovery with one he himself had submitted to the late Sir Robert Peel, and which will come before the public as soon as it can make an appearance suitable to its importance; wherefore, complying with the conditions laid down for correspondents, but concealing his name from the public (therefore evidently aiming at nothing more than he professed, viz., to reserve a claim on behalf of this country), he solicited the insertion of a letter confirming the statement of De Vignernon (however improbable it may appear), but contending, if such a thing had been done by this gentleman, it had previously been done by an Englishman; and predicting the time not far off, when the beautiful and costly steam engines would be reduced to the value of old metal.

But, as if to make good the charge of the "Edinburgh Review," that though the "Times" would go in any direction and to any lengths with the masses, it never lent a helping hand to any individual, however situated, my missive, self-denying as it was, could not find entrance. In a few months it may be important, in claiming our share of the merit of the discovery, to have this letter in your columns to refer to.—I remain, respectfully yours, J. W. P.

Walcot Place West, Lambeth, Dec. 3, 1851.

STANNARD'S PERPETUAL MOTION MACHINE.—We have just been given to understand that an artisan in very humble circumstances, residing in Ipswich, has, after three years' labour, succeeded in constructing a model of a machine, 15 inches by 13, and 11½ deep, which is self-acting, after being put in motion by a screw. It is powerful enough to turn a grindstone against the power of one person who had an iron bar on the stone. It has kept in motion upwards of 36 hours, at the end of which time the speed was not diminished; and the constructor, whose name is Thomas Stannard, contends that the machine will keep in motion as long as the materials will last. The invention was offered to several firms in Ipswich, who declined taking it up, since which three persons belonging to one of the first firms of engineers in London have visited Ipswich, and examined the machine, and have been induced to pay the inventor liberally, and have taken the machine and the inventor to London to prosecute inquiry.—[" Ipswich Express." (1853 ?)]

ALLEGED DISCOVERY OF A SELF-MOVING MACHINE BY JOSEPH HUTT.—A correspondent in the " Leicester Mercury" writes as follows:—

A poor framework-knitter, named Joseph Hutt, now living near the Church, Hinckley, has, after twenty years' application and study, completed a machine, which he calls a " self-moving machine," or perpetual motion; and he is very confident of its being fully entitled to the term "perpetual;" and, also, that its power may be increased almost to any extent. From his own account and description of the machine, it appears that he set it in motion on the 26th of August last, since which time it has continued to work exceedingly well, and with the greatest ease and regularity; and that it is so constructed as to bid fair to become one of the most useful inventions that has hitherto been discovered. Its motions are both quick and powerful, and may be applied to anything to which mechanics may think well to apply it. It does not require the aid of steam or any other power to keep it in motion, having one continued and regular movement of its own. Its bearing arm wants no repose, and it will continue as long as the materials it is made of. The simplicity of the machine

is such that the inventor is afraid to allow any person to see it. He is desirous of bringing it out in a more finished style, but this he cannot accomplish under £20, which sum he is too poor to raise.—[" The Mining Journal," vol. 17, 1847, p. 532.]

In relation to the same, we read in the " Builder," June, 1847, that—

This vain delusion, if not still in forse, is at least as standing a fallacy as ever. Joseph Hutt, a framework-knitter, in the neighbourhood of the enlightened town of Hinckley, professes to have discovered it, and only wants £20, as usual, to set it agoing.

IS PERPETUAL MOTION AT LAST DISCOVERED ?—An intelligent friend, in whom we have confidence, writes to us gravely from Lille, to state that a mechanic there, after thirteen years' effort, has positively obtained the means of perpetual motion. Parties have formed themselves into a company to bring the discovery before the public, and on Tuesday (8th August) in last week, a meeting of these, including some engineers connected with mines, was held to witness the machine in operation, and the only objection made, according to our informant, was, that it was not applicable to navigation; but this the inventor denies, maintaining its applicability to all purposes. The present machine is of wood, but it is decided to make one of iron. We need scarcely say that we are not believers in perpetual motion, having the word "friction" floating in our mind, and we have often cautioned correspondents against being led into so dangerous and difficult a chase; but in this case the circumstances are put before us by so careful a mind that we are bound to wait rather than to scoff. A belief prevails that the British Government some time since offered an enormous premium for the discovery of this power, but we are disposed, after inquiry, to consider this belief erroneous.—[" The Builer," August, 1848, vol. 6, p. 406.]

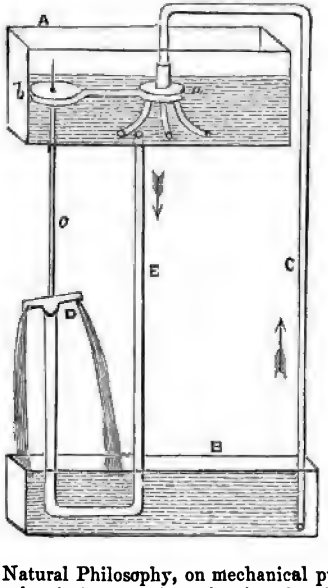
PERPETUAL MOTION.—In detailing the steps which led to the formation of his theory of motion, Mr. Pasley (of Jersey) says in his Preface:—

For a number of years the discovery of a perpetual

motion occupied my thoughts, and at every mechanical device I could imagine my leisure hours were employed. The pursuit brought me acquainted with my own errors. Nothing disheartened by numerous failures, I gave up all idea of employing mechanical means, but looked to the planets in search of the cause of these bodies performing perpetual motion; and being convinced that self-motion of a mass of inert matter is an absurdity, it appeared to me a matter of certainty that planets must be involved in a medium on the pressure of which their motions depend. * *

It is almost needless to mention, I felt ambitious to be the discoverer of the cause of motion, if not capable of effecting a perpetual motion; still, by experience taught, I may be blind to some fundamental mistake which I am incapable of discovering.*

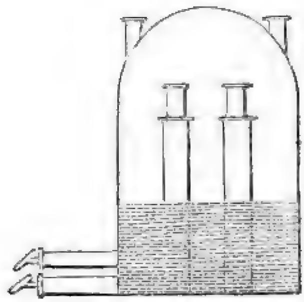
Eaton's Perpetual Syphon.—This is a plan proposed



* A Theory of Natural Philosophy, on mechanical principles, divested of all immaterial chemical properties, showing for the first time the physical cause of continuous motion. By T. H. Pasley. 8vo. Whittaker, London, 1836.

by Mr. Eaton, in 1850, and consists in providing two water cisterns A, B; the short leg of a syphon C enters the upper cistern, and terminates in three escape pipes, capable of being rotated by the pulley *a*, connected by a band with the pulley *b*, affixed to the vertical shaft *c*, rotated by the inverted Barker's mill D, constructed on the short leg of the inverted syphon E, supplied from the bottom of the upper water cistern. By this means it was expected to keep up a continual flow down the pipes C and up E, as shown by the arrows.

LEGGE'S HYDRO-PNEUMATIC POWER.—Mr. Legge gives the annexed sketch of an invention, the result of fourteen years' study. It is a dome-shaped vessel; its upper part A filled with air, and the lower half with water, as at B.



This vessel contains two apparatus for returning the water which is worked through C D, apparently like pump barrels. The air is to be at from 250 to 500 pounds' pressure on the square inch. When once started it will (it is stated) go on as long as it is oiled. The inventor estimates a one thirty-second share at one thousand pounds value.

FOSTER'S WHEEL OF INCLINED PLANES.—Messrs. Spon have communicated, by a large drawing, the plan of Mr. Foster, of New York, for producing perpetual motion by a

series of inclined planes set round the periphery of a wheel, each incline having a roller retained on its surface by two side rods, each pair connected at one end to the rollers, and at their other ends to the sides of the wheel, by means of pins, allowing them free rolling motion. It was expected that on turning the wheel in a direction to carry the rolling weights down an incline on the central horizontal line, and consequently farthest from the centre of rotation, the other inclined planes would follow in succession, and deliver their rolling weights in like manner. But innumerable trials proved, after a large outlay of money, that gravitation was not to be overcome by any such means. An eminent engineer considered this method so feasible, that he devoted considerable time in practically testing the several model apparatus constructed by the equally or more sanguine inventor.

PREDAVAL'S PATENT MOTIVE POWER COMPANY.—The following particulars are taken from the prospectus of the above intended-to-be-formed company, for it most likely never went so far as to apply for its proposed "capital £1,500,000, in 3,000 shares of £50 each; deposit £3 per share," notwithstanding the flattering expectancy held out that "we shall have £2,000,000 annual profit."

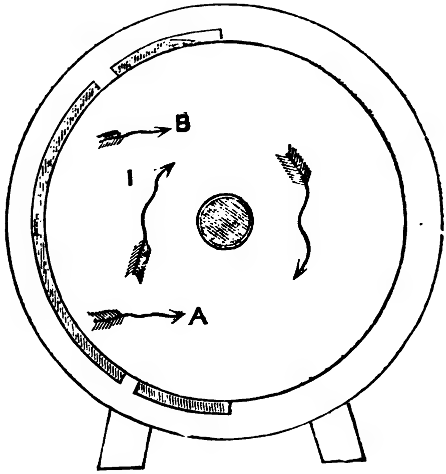
The prospectus, consisting of four folio pages, is curious enough to deserve being copied entire, but the following extracts must here suffice:—

Importance and Advantages of the Motive Power.—The following considerations are sufficient to prove to the shareholders that a large benefit may be realized.

There are, in the united Kingdom, about 20,000 Steam Engines, of a mean power of 50 horses. The advantages of this motive power, in comparison with the steam engine, are so plain and enormous, that there is no doubt that it will be applied at least to all the existing steam engines, without considering the newly-constructed ones; and supposing only £2 for each horse power every year, for the licence, or for the profit of construction, we shall have £2,000,000 of annual profit.

This invention will open a new epoch of prosperity for the

(*Fig. No.* 1.)



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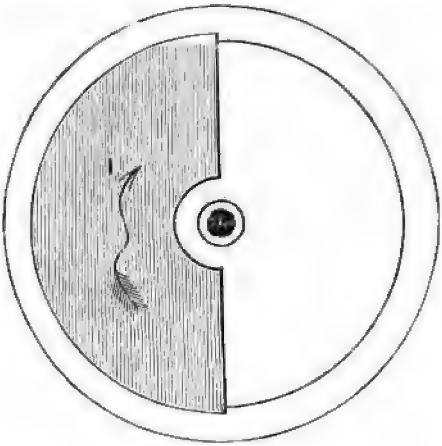


English constructors, seeing that the accuracy with which the machine requires to be constructed will oblige foreign nations to send their orders to England. The low price of transport will encourage the export of coal to foreign countries, with the other productions of the kingdom, and will produce a new source of riches to the nation.

This invention is worthy of the patronage of all persons, and all departments of the Government, considering its economy and security.

Specification of the Patent.* (Sealed 1833. No. 6510.) —The invention is an attempt to obtain a rotatory motion from a hollow drum or cylinder, mounted on an axle, turning in bearings in an outer air-and-water-tight case; the space between the case and the drum being divided in a vertical direction by an air-and-water-tight partition, into two compartments; one is filled with a fluid, and a vacuum is produced in the other by a pump, or by the adhesion of the surface of the half air-tight case upon the half drum, when it is expected that the tendency of the part of the drum which is in the liquid chamber will rise by its buoyancy, and the inclination of the other part, or that in the vacuum, will fall by its gravity, and will produce a rotatory motion as long as the vacuum is kept up in one chamber and the liquid is in the other.

The surface of the drum, in cast-iron, should be perfectly smooth; and the plates of the air-tight case upon the half drum should be in gun-metal, perfectly smooth; and by a friction with mercury the surface will be covered by it, and will destroy the adhesion of the metal upon the surface of the drum.

The general claim is, "A machine acting by a joint power derived from the buoyancy of a body in fluids, and the weight of a body in vacuum."

When the parts are put together, they are secured by screws, the joints being made air-tight.

Fig. No. 1,—is a side view of an Engine constructed on the principle of this Invention, with the outer cover being removed to expose its internal construction.

Experiment made without expense, by every person, to ascertain the efficacy of this Motive Power.—Put in a vertical

* See Chapter XI., under date 1833, No. 6510.

direction into the water, the half drum in wood (A B C, Fig. 1) until it is surrounded; and taking it easily in the fingers, it will turn round according to the pointed line A E.

Take easily in the fingers the other half drum (Fig. 2), and in a vertical direction, according to the letters F G H, hold it in the air, and it will fall by gravitation according to the line H I.

The force with which the No. 1 will rise is equal to the difference between the body of the half drum and the body of the volume of water displaced,—minus the friction of the axis in the fingers, and the friction of the liquid upon the surface of the half drum.

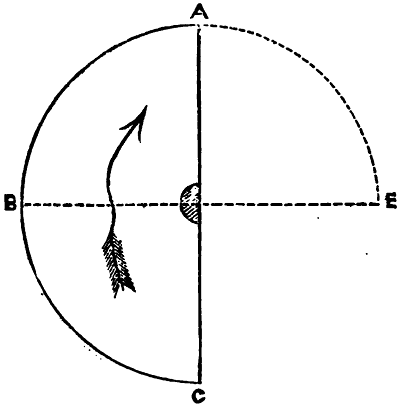
The force with which the half drum (No. 2) will fall is equal to the difference between the body of the half drum and the body of the air displaced,—minus the friction of the axis in the fingers, and the friction of the air upon its surface.

All this is practical; and it is plain that it will turn upon every scale. This experiment proves that the force with which the two half drums move is more than the friction of the axis against the fingers, and the friction of the liquid against the surfaces of the drum.

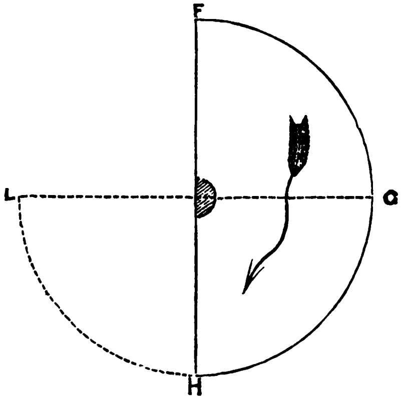
By the practical construction of steam engines, I prove, in the following numerical report, that the friction to prevent the fluids going into the vacuum chamber, or into the plates at air-tight upon the half drum, is less than the motive power; and that there remains sufficient to produce a disposable force. For instance, it must be considered that upon a small scale a little difference in the construction will destroy the motive power, but that will not be the case upon a large scale, because a great power will easily destroy too hard a friction.

Numerical Illustration, applied to a Machine in which the diameter of the drum is 5 feet, and the length 2 feet.—Hydrostatic Laws: "Fluids press in proportion to the height of their levels, in every direction; but the greatest pressure is that from the bottom to the top of the vessel. When a body is entirely, or in part only, immersed in a fluid, the horizontal pressures exercised by the fluid upon its surfaces are mutually destroyed. The result of all the vertical pressures is equal to the weight of the fluid displaced, and directed in opposition to the gravitation, applied to the centre of gravity, of that portion of the fluid displaced; and the

(*Fig.* 1.)



(*Fig.* 2.)



body loses a part of its weight equal to the absolute weight of that portion of fluid displaced."—(See the above indisputable practical principles in Hydrostatics and Mechanics, by Poisson.)

After a variety of calculations and statistics, we are informed, in the concluding observations of this lengthy prospectus, that—

This motive power is applied also to the steam engines existing; we want only to take out the boiler and the pistons. We need scarcely say that we can obtain any number of horse power, and that, by its simplicity, this motive power can be applied to all things wanting force.

Every person laughs at what is called "perpetual motion," but a very small number know what that expression signifies. D'Alembert's Encyclopædia, at the word "Perpetual," says, "Perpetual Motion is a machine working by itself, without any external force, and only by gravitation of matter." At the first sight, it is plain that by the gravitation we shall only obtain a movement for a limited time; after which the equilibrium will succeed: but it must be considered, that in the above system there are two forces—one is gravitation, the other is the impetus with which every fluid has a tendency to raise the body surrounded by it in a direction opposite to the gravitation. This tendency is continuous in every fluid; consequently, in this machine the property of the motive power is continuous; but not the machine, which requires the plates to be repaired every three years. If anybody was to ask me to show them a machine at work, I should answer—The globe is one;—the earth turning by this system, half only being surrounded by water: and in general, all planets turning upon their axes are surrounded in part by fluids; the moon not turning upon its axis, because it is deprived of fluids.

The engineers' constructors possess and know the construction of a smooth plate, and a piston in a cylinder; these are all the pieces necessary for the working of the machine. The complement to go more or less quickly, or to stop, is the same as that employed in steam engines, according to the circumstances and the application.

CHAPTER XI.

PATENTS OF THE NINETEENTH CENTURY, FOR IMPROVEMENTS IN OBTAINING MOTIVE POWER: ENGLISH, FRENCH, AND AMERICAN.

UNDER the Patent Laws previous to October, 1852, at which period the present amended law came into operation, the cost of a patent for the United Kingdom was little short of £300. The new law provides for obtaining patents progressively both in respect to time and payment; that is, protection for six months, on depositing a provisional brief outline specification, extensible, at the option of the patentee, to three, four, and seven years, making a total of fourteen years, as heretofore, and the fees at each stage being very moderate. The facilities thus offered by the present system occasion the patenting of a large amount of frivolous and crude schemes, entered on without investigation as to former claimants or the merits of the supposed novel inventions. This accounts for the immense number of subjects patented of late years, which never proceed beyond six months' protection.

A few early patents were granted on the mere title, unaccompanied by any description, as noticed in Chapter III. In later patents it was only required, and so continued to be to the end of September, 1852, to file a specification of the invention sought to be protected, before the six months expire, until which was done, the invention was only known by its title; and if not filed, as required, the patent in consequence lapsed. But under the existing law, a brief or provisional specification, ascertaining the nature of the invention,

must be put in on making the first application, otherwise no protection is granted; and before six months expire, a complete specification has to be lodged, fully detailing the invention. Instances of all these cases (except void patents) will occur in the following Catalogue Raisonné, that is—1. Patents granted on the mere title. 2. Others not specified, and therefore void. 3. Such as have not gone beyond provisional or six months' protection. And 4. Those fully specified.*

Patents of the seventeenth and eighteenth centuries have been given in Chapter III., to which one patent for 1801 was transferred from the present period, to be there associated with critical notices from contemporary scientific journals. The patents here enumerated may be said to have fallen dead born, having excited no notice or attention in scientific circles. All interest in them has been confined (with one exception) to the inventors themselves, who, though they have laboured seriously and sedulously, have elicited no new fact. The display their efforts make in the following pages is anything but flattering to their knowledge, ingenuity, or practical skill. Nothing can be more disheartening than such a scene of wreck and blighted hopes; and the sad picture should prove a salutary warning to all adventurers setting out on this shoreless ocean of enterprise.

1809.—William Pleasants [No. 3226], of Abbey Street, Dublin, Bachelor of Arts. "A self-mover, or machine which can keep itself in motion." He says:—"My invention consists in causing water to ascend through inclined pipes in consequence of the centrifugal force communicated to it by the whirling of the vessel (partly filled with water) whereinto these pipes are inserted, which whirling motion is occasioned by the same fluid in its descent turning a wheel on the axle

* It may be useful to mention here that printed copies of all specifications can be obtained at exceedingly moderate charges, at the Great Seal Patent Office; all that is required being to name the *date* and accompanying *number*, each of which is given throughout this and the former list.

which passes up through and is fixed to that vessel." This is the old story, and as there is nothing remarkable in the apparatus it need not be farther described.

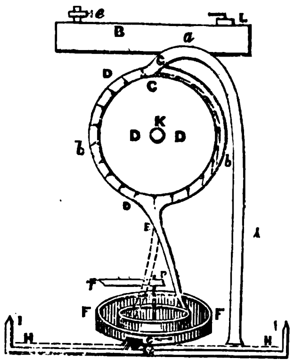
1814.—HENRY JULIUS WINTER [No. 3861], of Dover, Kent, Confectioner. "A method of giving effect to various operative processes."

I construct a set of water-wheels, overshot, breast wheels, or other wheels, of such construction as that the whole or nearly the whole of the charge of water suitable for giving motion shall be employed in so doing. And I place the wheels of the set or series in such positions with respect to each other as that one of the wheels shall be worked by water, conveyed thereon; and that the second wheel of the series, shall be worked by the very same water, which I do for that purpose immediately convey from the tail of the first wheel unto the head or upper working part of the second wheel; and moreover, that another, or the third wheel of the series (if consisting of more than two wheels), shall be worked by the very same water, which I do for that purpose immediately convey from the tail of the second wheel unto the upper working part of the third wheel; and I do in this manner proceed by conveying the very same water from wheel to wheel, however numerous the set may be. And I cause the water to be received into a cistern. And I do infer, that the force of rotation by the said means produced in all the said wheels, or that the sum total of the rotatory force in all the said wheels, will be more than sufficient to raise to the first level the whole or as much as the whole of the water so employed in working the said wheels; and that I do accordingly, by the connexion and adaptation of a pump or pumps, or other fit hydraulic engine, with or unto the said wheels, raise again the said water, or an equal quantity, and do employ the water so raised in communicating and maintaining the rotatory force of the said set or series of wheels, as before shewn; and that I do, by other communications from the said wheels, give effect to such various operative processes as require machinery to be moved by employing the excess of the rotatory force for this last purpose, which shall be over and above

what would be adequate to raise and return the water as aforesaid. And lastly, I do declare that the power or force so to be generated will not cease to be augmented unless employed, count poised, or stopped, by some force extrinsic, and proceeding from some other source or cause (except the wear and decay of materials) than any which would exist in the set or series of water-wheels combined together and worked as aforesaid.

1819.—Robert Copland [No. 4364], of Liverpool, Merchant. " A new or improved method or methods of gaining power by new or improved combinations of apparatus, applicable to various purposes."

Figure 1 is a view of a machine by which I purpose to derive a disposable force or power from the action, weight, or pressure of the atmosphere, through the medium of the column of water or other heavy liquid descending on one side of the enclosed vertical wheel, and from thence through the centrifugal wheel, being returned into the same reservoir, from which the pressure of the atmosphere raises it to be again delivered on the top of the vertical wheel to supply the discharge on the descending side, arising from the centrifugal force communicated to it by the rotatory velocity of the centrifugal wheel, and the pressure of the descending column overbalancing the re-action or resistance of the atmosphere at the discharging apertures of the centrifugal wheel. Thus a small quantity of water or other liquid (according to the size of the machine required) being continually returned on to the top of the vertical wheel by the pressure or action of the atmosphere, and acting by its unbalanced gravity or impetus in its descent, will produce a disposable force or power of any required magnitude, by increasing the size or number of the



machines, provided the height the fluid is required to be raised is not quite so high as the column which the atmosphere when lightest will raise of that fluid, and allowing for the requisite velocity on to the vertical wheel. In Figure 1, A is the feeding pipe through which the fluid is raised by the pressure or action of the atmosphere on the fluid in the lowest reservoir, in which the lower end of the pipe is immersed, closed by a cock, sliding plate, valve, or shutter, to allow the machine to be filled at the commencement, and which may be under the surface of the fluid, also to keep it air-tight. The other end is inserted air-tight into the top reservoir, or by a curve, as shewn by the dotted line *a*, joined to pipe C, and delivering upon the vertical wheel, without any top-reservoir. In this case, if water is used, the highest part of the bend or curve inside should not exceed thirty feet above the level of the water in lowest reservoir. B is the top reservoir, the lowest internal part of which should never exceed twenty-nine or thirty feet above the water in lowest reservoir, but it will admit the top of the reservoir, if wished, to be rather higher than when the curved tube *a* only is used. It must be quite air-tight, and supported as convenient. C is a pipe, joined air-tight to top reservoir, or forming part of A, *a*, C. C is a moveable flap of strong leather, or other substance, which may be joined to the lowest part of C, where the water is delivered so high on the wheel, and where floats with hinges are used on the wheel to prevent its going down on the ascending side; but not necessary when water is delivered lower on the wheel. D, D, D, D, is the fixed and immoveable waterway, and the fixed case or cover (of the vertical wheel), of which it is a part, joining also the stuffing boxes, through which the axle of the vertical wheel moves air-tight, thus entirely enclosing and surrounding every part of the wheel but the projections of the axle, and allowing the float boards and wheel just to turn freely in it without touching in any part except the axle in turning in the packing of the stuffing boxes; the float boards are fastened on to the rim or sole of the vertical wheel by very strong hinges or moveable joints just within the fixed waterway D. E is a pipe or pipes joined air-tight to the fixed cover or case enclosing the vertical wheel where the water is to be taken off it, having their lower ends inserted air-tight also into the bottom of the fixed and

immoveable top of the centrifugal wheel in such a direction that they may deliver the water into the moveable waterway of the centrifugal wheel as near as possible in the same direction as the water circulates in the wheel. F, F, is the centrifugal wheel, of any diameter convenient, according to the size of the machine, placed horizontally above the fluid in the lowest reservoir, so as to move on its axis as near as possible to the surface of the fluid without touching it, having an immoveable cover or top, leaving a hollow waterway round the rim, into which the fluid is discharged from E in the direction of the wheels' motion. G, G, are the discharging apertures of the centrifugal wheel. H, H, is the surface of the fluid in I, I, the lowest reservoir, containing a sufficient quantity of water, when the machine is put to work, to allow the bottom of feeding pipe A to be immersed in it at least two feet below the surface, or a greater depth may be given to that part of the reservoir under the mouth of pipe A, forming a sort of well in which A may be inserted any required depth, better to exclude any particles of air or bubbles mixed with the water nearer its surface from ascending in pipe A. This reservoir should be large enough to contain the whole of the water used before the machine is filled. K, K, are the ends of the axle of vertical wheel outside of the stuffing boxes of the fixed case, and are the only parts of the vertical wheel seen, and turning air-tight through the packing or stuffing boxes, or in any other manner the external air is entirely excluded from the vertical wheel when at work; *e* is an air-tight cock to discharge the air out of the machine when filling. L is an aperture into top reservoir, or into highest part of pipe A, *a*, when no top reservoir, closed air-tight by a screw cap; by this the whole machine is filled in every part with the fluid used before it can be set to work, the bottom of pipe A and apertures G (as well as cock to bottom of pipe E when required) being previously closed. P is part of the axle on which the centrifugal wheel revolves. Before the machine can be put to work, everything being previously arranged as directed, the apertures at G and bottom of A (and at E if required also), must be closed by sliding plates, valves, cocks, or other methods, as most convenient, and every part of the machine must be filled with the water or fluid used by the aperture L, or any other convenient method by which the

highest parts may be filled, the air allowed to discharge by opening E and O, the latter to be shut as soon as the centrifugal wheel is filled, and the cock at E closed where required, when the water is above it a little, *e* continuing open, so as to allow the air to be entirely discharged from every part, which being done, and the machine entirely filled with water, this cock and aperture L must be carefully closed; having then fixed upon the most convenient method for givin gthe required assistance to set the machine to work, by giving the centrifugal wheel motion, and assisting it till arrived at the velocity fixed, it must be put in motion, and the apertures G opened; after it has got a little into motion, and as soon as the velocity of the wheel has given a centrifugal force to the water sufficient to overbalance the slight difference in the height of the feeding and descending columns, the pipe A must be opened; a discharge from the apertures G will now take place, which is supplied from top reservoir B over the loaded side of vertical wheel, where, by its gravity and impetus acting on the float boards, it causes the wheel to turn till it descends, so as to be discharged through E, on to the rim or waterway W, of the centrifugal wheel, which it strikes with the velocity of its descent in nearly the direction of the wheel's motion, and is discharged through aperture G into the water contained at commencement in lower reservoir I, from whence this discharge is again supplied by the pressure of the atmosphere, returning it through pipe A into top reservoir, or through *a*, C, and the part intended of the vertical wheel. As the velocity of the centrifugal wheel is accelerated, the velocity of the descending column over the vertical wheel will also be accelerated, and, consequently, the vertical wheels, when having arrived at their respective fixed velocities, the assisting force being no longer necessary, may be withdrawn, and the centrifugal wheel may now receive what assistance is required to support its velocity from the vertical wheel through the connecting shafts and wheelwork, or in any other manner.

1823.—ROBERT COPLAND [No. 4749], of Wilmington Square, Middlesex, Gentleman. "Combinations of apparatus for gaining power, part of which are improvements on a

patent already obtained by him for a new or improved method or methods of gaining power by new or improved combinations of apparatus applicable to various purposes."

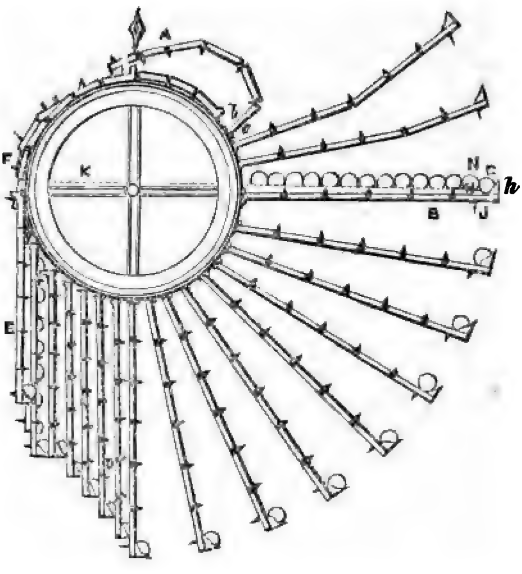
He says;—"Figures 1 and 2 represent a double machine with the connecting pipes or hollow tubes, in the parts of which most convenient for opening and shutting occasionally are placed cocks, valves, or slides, No. 1 to 8, and lower valves 11 and 12, or other substitutes for these, which may be shut or opened when required by any of the well-known methods, from the motion of the beams, or by the hand, or any other method. C 1 and C 2 are hollow iron cylinders of equal contents, connecting together at bottom, where valve 11 opens or closes the communication; they have close air-tight covers or tops, with stuffing boxes for the rods to pass through, and the pipes being connected by air-tight joints." We then have "hollow cylinders, having pistons working in them; pipes inserted through these bottoms; an open trough or waterway joined on the top of these cylinders; four vessels or weights moving freely in the four cylinders, suspended by rods passing through stuffing boxes in the close tops;" and so on throughout seven printed folio pages. We have here a large amount of complication and friction.

1836.—Robert Copland [No. 7216], of Wandsworth Road, Surrey, Esquire. "Improvements upon patents already obtained by me for combinations of apparatus for gaining power." The engine has a working beam and cylinders, like the preceding, but differently worked, without any appearance of being self-movng.

1821.—George Linton [No. 4632], of Gloucester Street, Middlesex, Mechanist. "A new method of impelling machinery without the aid of steam, wind, air, or fire."

My invention consists in a vertical wheel moving by gravity alone, such wheel being fixed on an axis, which is made to turn easily in gudgeons, and the periphery of which wheel is provided with levers so constructed that by the mere revolution of the wheel they extend themselves to their

greatest length, and obtain their greatest acting power successively as they arrive by the rotative motion of the wheel at that position where they become situated at the upper part of the lower quadrant of the descending side of the wheel, and in which last-mentioned position they charge themselves with a weight at that extremity farthest from the axis; and which levers also cease to act as levers the moment they have passed the lower part of the said quadrant, and being carried up in an inactive state with the ascending side of the wheel, discharge the weight when the said weight arrives at some point above the level of the axis; and in causing the said weight, and others so discharged, to return, by gravity alone, to the situation whence they were taken by the levers before-mentioned.



I will here observe generally, that the principle of my invention being applicable to a series of vertical wheels on one axis, as well as to a single vertical wheel, and a series of vertical wheels being in my opinion preferable for the purpose

of practically applying my invention, I have described the principles of my invention, as applying to such a series. Fig. 1 is an end view of a series of vertical wheels, one only being seen, while the levers attached to the whole are visible. In Fig. 1, the lever A is represented in the act of falling from the periphery of the wheel into a right line. The lever is composed of a series of flat rods connected by ruler joints, which said ruler joints are provided with a stop or joggle to prevent their collapsing at any time more than will bring any one of the rods which compose the levers at a right angle with the rod next to it. This lever is attached to the periphery of the wheel by the hinge joint *b*, being provided with the shoulder *c*, to prevent its falling into any other than a right line from the centre of the circumference of the wheel. The levers are furnished at their outer extremity with a bucket or receiver, the bottom of which is sufficiently broad to retain the ball G; at *h* is a small roller to facilitate the delivery of the ball. The ball remains in the bucket till the lever comes into the position of the lever F, when is will roll out of the bucket on to the inclined plane, and by its own gravity roll to the balls at the other end of the inclined plane, ready to be again taken into a bucket. The stage which supports the inclined plane should not have any connection with the axis.

[The intended operation of this wheel is too obvious to require further description.]

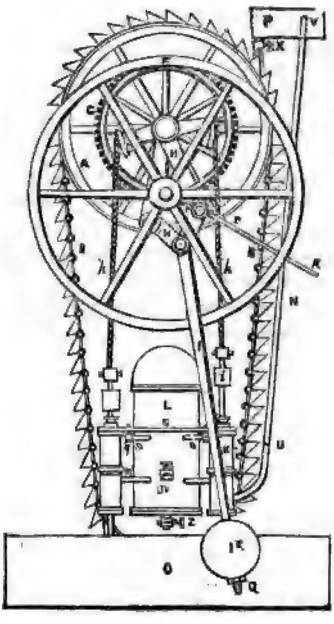
1825.—Edward Jordan [No. 5191], of Norwich, Engineer. "A new mode of obtaining power, applicable to machinery of different descriptions."

This is a singularly impracticable invention, yet the patentee claims that it "consists in sinking or forcing down to any convenient depth under water, buoyant vessels, by or with a lever, and also in directing and conducting them when so immersed, so that they are alternately placed in a position to act upon parts, forming in effect a lengthened portion of the lever that depressed them, thereby obtaining by a new mode a power applicable to machinery." Two large drawings and seven printed folio pages complete the specification.

1827.—Sir William Congreve [No. 5461], of Cecil

Street, London, Baronet. "A new motive power." Enough has already been stated in respect to the inventions herein protected. (See Chapter IX.)

1832.—PIERRE NICOLAS HAINSSELIN [No. 6290], of Duke Street, St. James's, Middlesex, Architect and Engineer. "A machine or motive power for giving motion to machinery of different descriptions, to be called 'Hainsselin's Motive Power.'"



I do declare the nature of my said invention to consist in a machine, the nature of which depends on the descent of an endless series of reservoirs filled with water, which water is raised to a suitable elevation for the purpose, principally by the action of the machine itself.

No. 1 represents a front view of the machine, and No. 2 a side view; similar letters of reference being used to denote similar parts. A is a large drum; B, B, an endless series of reservoirs, or (as they would be called on a water wheel) buckets, each fastened by a hinge joint to the other, so as to form an endless chain, passing over the drum; C is a cogged wheel, working into the pinion D; and E is an eccentric, more particularly explained hereafter; F is a fly wheel; G, G, is a balance beam, carrying the segment of a circle at each end; H is what I call an escapement for I, which is a pendulum; and I 2 is the weight of the pendulum; K, K, are two pumps; L is the main cylinder of the machine; M, an air pump; N, a pipe, through which the water which works the engine is raised; O is a reservoir to receive the water from the descending buckets; and P is a reservoir to receive the water from the pipe N: and when it is required to make one of the said machines, the following details must be observed:— Suppose, for instance, it is required to make a machine on my plan, equal in power to a steam engine of which the expansive is equal to a resistance of 1,000 lbs. in a second. It will be seen that air and water are the two principal agents in me machine; water, it is known, weighs from 60 to 62 lbs. thy cubic foot, and it requires 32 cubic feet of air to balance one cubic foot of water; and I have found, by various experiments, that my machine employs about three-fourths of its power to produce it own action. From these premises it results that in order to have a machine on my plan equal to 1,000 lbs. per second, there must be 4,000 lbs. of water in the descending buckets, and two hundred cubic feet of air condensed in the cylinder L, by means of the air pump M, which is worked by hand by the lever handle *a*. The drawing represents sixty-four buckets fastened together by hinge joints in such manner as to form an endless chain of buckets, their motion being so contrived that they descend full at one side of the drum, and rise empty at the otherside, the drum being about three feet six inches in diameter; twenty-five of these buckets can retain water in the same time; and in order that the united weights of their contents may be 4,000 lbs., it is necessary that each of the sixty-four buckets shall be of a size (whatever be their form) conveniently to hold 160 lbs. of water. In order to supply twenty-five descending buckets with the required quantity of

water, the two pumps K, K, are placed a little above the lower reservoir O; the rods of these pumps plumb with the extremities of the balance beam G, G, by which they are worked; the capacity of each of these pumps should be such that each stroke of the piston should raise a column of water to the upper reservoir P, sufficient for the supply of one bucket (that is to say, 160 lbs.); these pumps, which may be called hydro-pneumatic, are nearly like ordinary lift pumps, the only difference being that the pump chamber is divided into two parts by the division *f*, the upper part being furnished with the piston of a force pump; the same rod *e* works both the piston *d* of the upper part of the pump chamber *c* and the valve *f* of the lower part of the chamber *g*. The pump rods *e*, *e*, are fixed to a chain *h*, *h*, which is attached to the segments on the ends of the balance beam G, G, and thereby made to work the pump rods, while the balance weights *i*, *i*, below the extremities of these chains, keep them at a proper degree of tension, and keep the beam on a just balance. The strong cast-iron cylinder L must be capable of resisting the force of the condensed air which it is intended to contain, say, at least 240 lbs. The interior of this cylinder is furnished with a division *f*, by which an upper and lower chamber are formed, marked *k* and *l*. The lower chamber *k* is intended to receive the water which the pumps K, K, feed it with by means of the pipes *m*, *m*, at every stroke of their pistons, and in this chamber the water frees itself from the air which may have been pumped in with it, and which is suffered from time to time to escape at the cock *n*, when a quantity has collected sufficient in any way to retard the action of the machine. It is from this lower chamber that the water is supplied to the upper reservoir P. The upper chamber *l* of the cylinder L is destined to receive the air, which is to be forced into and thus condensed in it by means of the small air pump M. It will be seen that the two small pipes *o*, *o*, communicate with the upper chamber *l* of the cylinder L, and the upper chamber *c*, *c*, of the two pumps K, K; these pipes are to let in the condensed air upon the tops of the piston *d*, *d*, to cause the downward movement of their alternate action. *q*, *q*, are two valves, each furnished with a lever *t*, *t*, which levers are connected by a jointed cross bar S, as shown in plan in the margin of the drawing No. 1. As the two arms or levers *t*, *t*, of this contrivance project beyond the vertical line of the

pendulum I, they are acted upon alternately by the vibration of the pendulum, thus alternately opening and shutting the valves *q*, *q*. The lower reservoir O may be of any convenient capacity, but the upper reservoir P should, at least, be able to contain as much water as twenty-five of the buckets can hold; and the ascending pipe N, through which the water is raised from the lower chamber *k* of the cylinder L to the upper reservoir P, should be of such a diameter as to contain exactly the quantity of water required to fill three of the buckets in the space between the point *u* (which should always be in a line with the division *f*) and the point *v*. The cock X is to regulate the descent of the water from the reservoir P into the buckets, which should be just equal to what is pumped up by each pump at each stroke of the piston. *y* is an air cock communicating with the upper chamber *l* of the cylinder L, and is to let a portion of the condensed air escape when its too great density causes the engine to work at too rapid a rate. Z is a cock for emptying the lower chamber of the cylinder L when necessary for repairs or otherwise, and a similar cock or valve should be made to the lower reservoir O, in case at any time it should be required to empty it. As it is necessary that each bucket as it empties itself should be replaced by a full one, the pinion D should be so regulated with reference to the toothed wheel *c* (which is fixed on the same axis as the drum A), that at every half revolution of the fly wheel F (which gears in with the pinion D, and is on the same axis with the eccentric E), one of the buckets shall present itself in turn under the cock X to be filled. The pendulum I is fixed on the same axis as the balance beam G, G, and the object of the eccentric fixed on the axis of the fly wheel is to act upon that part of the pendulum which I call the escapement at *r*, thus propelling the pendulum to one side, while as soon as the eccentric turns away from *r*, and it thus escapes from the action of the eccentric for a time, its own weight brings it back to be acted upon by the eccentric again, thus keeping up the vibration of the pendulum. The jointed bars at H, H, H, H, which I have called the escapement, form a part of the rod I. This rod is furnished with the weight I 2, which may be raised or lowered on the rod I, by turning it to the right or left on the thread of the screw Q, to regulate the motion of the pendulum; and this motion may be further regulated by the segment bar and adjusting screw, which

expands or contracts the jointed bars H, H, H, H, of the escapement, at pleasure, and thus allows an increased or diminished action of the eccentric on the part *r* or the escapement; R is a lever to throw the pinion D in and out of gear with this fly wheel F, in order to stop the machine or put it in action when required; and it may be well here to describe that the is effected by means of the small arm, which, when in gear, protrudes through a hole in the flange of the pinion; but when the pinion is drawn away from this arm, the fly wheel and all upon its axis stops, and the pinion turns harmlessly with the toothed wheel.

This verbose description is followed by describing how the invention is to be worked, which it is needless to inquire into.

[In the "Description des Machines et procédés pour lesquels des Brevets d'Invention out été pris;" Paris, vol. 33, p. 239, is an account of a "Machine hydropneumatique, dite Machine Hainsseline," Laporte, October, 1836.]

1833.—BARTHELEMY RICHARD COMTE DE PREDAVAL [No. 6510], of Leicester Place, London, Engineer. "An engine for producing motive power, applicable to various purposes." It comprises an outer circular case, supported on a stand, having a corresponding hollow water and air-tight cylinder turning on an axis, working in a stuffing box; this axis is fixed to a drum, and passes through the case at each side, which supports it. This frame contains pistons or friction plates occupying the space between the inner drum and outer case on all four sides. There is an air cock, mercurial guage, springs, leather packing, metal plates, &c, &c. Y t in spite of all this complication, we are informed the engine eacts "by a joint power derived from the buoyancy of a body in fluids, and the weight of a body in vacuo."

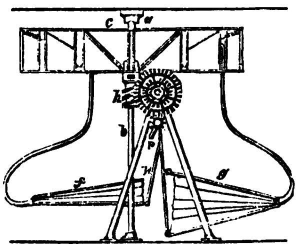
NOTE.—This patent was made the subject of a joint-stock company. (See conclusion of Chapter X.)

1839.—JACOB BRAZILL [No. 8312], of Deptford, Kent, Governor of Trinity Ground. "Improvements in obtaining motive power."

My invention consists in a certain arrangement or combination of mechanism wherein the atmospheric air is employed

as the impelling agent, being brought to bear in such a manner as by exerting a constant urging pressure, to produce a continuous rotary motion, and applies to all the purposes where a prime mover is required.

Fig. 1 is an end view of the apparatus. *a*, *a*, are the bearings, top and bottom, for the vertical shaft *b*, which bearings are to be so constructed as to produce the least possible amount of friction. *c* is a large drum furnished with radial plates or fans, some of the plates being so arranged as to slope down towards the bottom plate, thus forming, as it were, a series of boxes decreasing in their transverse dimensions as they approach the boss.



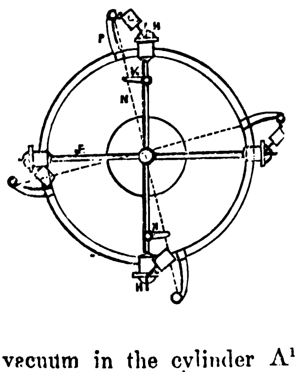
This drum is to be put in motion by means of a current of air directed through the pipes *d* and *e*, from the two pairs of double bellows *f* and *g*. *h* is a worm fixed on the vertical shaft by means of a tightening screw, or in any other convenient way, taking into the worm wheel *i* on the horizontal crank-shaft *j*, supported in bearings *k*, *k*. The cranks *l*, *l*, work the bellows, by connecting rods *m*, *m*; *n* is a spur wheel taking into a pinion *o*, on the axle of which is a winch handle *p*, for starting the apparatus.

What I claim as my peculiar right is, the impulsion of a current of air against the fans of a drum (as that at *c*) through pipes, as at *d* and *e*) for the purposes of a motive power, together with a certain arrangement of mechanism, by means of which the action first induced shall be kept up.

1842.—William Henry Stuckey [No. 9419], of St. Petersburg, Esquire. "A pneumatic engine for producing motive power."

Fig. 1 is a front view of my said pneumatic engine, partly in section. A^1 and B^1 two horizontal cylinders, united at their inner extremities *a*, *a*, which rotate on gudgeons that have their bearings C, C, in the upright standards D, D; A^2 and B^2 two pistons which work to and fro in these cylinders;

E^1 and E^3 two hollow arms or tubes which radiate from the cylinder A^1, and E^2, E^4, two similar arms or tubes which radiate in opposite directions from the cylinder B^1, each cylinder having an open communication with the arms or tubes attached to it. F^1, F^2, F^3, and F^4, four other cylinders, affixed to a circular ring R, R, open at top to the atmosphere, and open at bottom to the radial tubes E^1, E^2, E^3, E^4, connected with them at their outer extremities. G^1, G^2, G^3, G^4, pistons working in the cylinders F^1, F^2, F^3, and F^4, and H^1, H^2, H^3, and H^4, caps screwed on to the flanges of the cylinders. The different parts described form a wheel, which, on being set in motion, rotates on the gudgeons in the bearings C, C. The motion is produced as follows:—I adjust the wheel so that the tubes E^1 and E^3 shall be in a vertical position; and pour into the tube E^1, through the cylinder F^1, withdrawing the piston G^1, as much mercury or other suitable fluid body (previously determined by calculation) as will fill the tube from the point of its connection with the inner cylinder A^1 up to the bottom (a, a,) of the outer cylinder F^1. The mercury thus introduced flows into the cylinder A^1 at the back of the piston A^2, and



presses that piston forward to the extremity of its range, the piston G^1 being then restored to its place in the cylinder F^1, and pressed close down on the mercury in the tube E^1. I next turn the wheel till the tubes E^2 and E^4 are in a vertical position, by which turning the mercury therein is forced into the tube E^3, flowing down which it drives the piston G^3 of the cylinder F^3 forward to the extremity of its range, leaving a vacuum in the cylinder A^1 at O, equal to the difference between the heights from which the mercury descends in the tubes E^1 and E^3. I then fill the tube E^2 and cylinder B^2 with mercury, to the same extent and in the same way as I previously filled the tube E^1 and cylinder A^1, after which I turn the wheel till the tubes E^1 and E^3 are once more in a vertical position, whereby I produce a vacuum in each pair of tubes, and their intermediate cylinder, to the degree of the difference

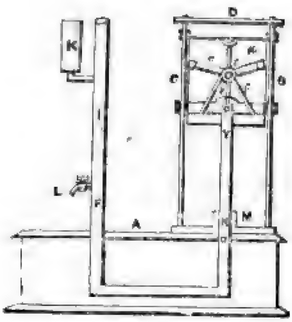
before explained. To the four tubes there are attached four cocks K^1, K^2, K^3, K^4, which, after the vacua have been obtained, are closed; and to the four rods of the pistons of the outer cylinders F^1, F^2, F^3, F^4, there are attached four hanging or balance weights L^1, L^2, L^3, L^4, in such manner that they shall co-operate with the atmospheric pressure on the said vacua in giving rotation to the wheel. M^1, M^2, M^3, M^4, are jointed levers, by which these weights are connected at one end with the pistons G^1, G^2, G^3, G^4; and N^1, N^2, are cords or bands, by which they are suspended at the other end from standards P, P, projecting from the ring R, and bearing pulleys, over which the cords or bands pass, each cord or band serving to suspend the two weights which are opposite to each other, for which purpose it is passed internally across the wheel and over the exterior of one of the cylinders A^1 or B^1. The cords or bands are attached to the weights at the lower ends thereof, and pass over small pulleys close to the points of connexion, so that the cords or bands, when pulled, may act the more effectually on the weights. It will be readily understood that when any two of the tubes are in a vertical position, and the mercury or other suitable fluid has descended to the bottom of the lower tube, its pressure on the piston of the outer cylinder G^1 or G^2, or G^3 or G^4, will cause the weight connected with that piston to turn inwards towards the centre of the wheel, by which movement a strain is exerted on the connecting cord or band N^1 or N^2, which throws up the opposite weight at top, and causes it to force down the piston of the top cylinder, or the surface of the mercury in the upper tube, whereby any excess of pressure at the bottom of the lower tube is transferred to the top piston, where it acts in aid of the atmospheric pressure on the vacua obtained in manner aforesaid. The four cocks K, have regulating rods connected to them in the way common in steam and other engines, so that as each tube comes into a vertical position the cock attached to it is opened, and as it passes from that position towards the horizontal, is shut. so that the mercury always retains its proper position in the tubes or cylinders, and is acted on by the pressure of the atmosphere at those points only where such pressure can be of service. The power of this wheel will be, of course, in proportion to the vacua produced in manner aforesaid, and to the altitude of the columns of mercury employed. The inner cylinders might be dispensed

with, and the tubes be made to communicate directly with each other, but I prefer, for most purposes, the arrangement which I have before described, with the two intermediate cylinders A^1, B^1; where the inner cylinders are dispensed with, I make use of eccentrics instead of the joined levers before described, to enable the weights to turn to the extent of about half a circle. The number of tubes also need not be limited to four, but increased to any convenient extent.

1845.—William Willcocks Sleigh [No. 10,711], of Chiswick, Middlesex, Doctor of Medicine and Surgeon. "A hydro-mechanic apparatus for producing motive power."

The nature of my invention consists in the application of hydrostatic pressure in a chamber by means of apparatus, and in such manner as to reduce the effect of the hydrostatic pressure in the said chamber, in whatever direction is opposite to that in which it is intended that the said pressure shall propel the said chamber, and thereby produce motive power, without depending upon any escape of water from the said chamber for that purpose.

Fig. 1 represents a vertical sectional elevation of the apparatus. The framework A A A A. B B, a foundation plate into which the two vertical pillars or guide rods C C C C are firmly screwed and held in position at their upper extremities by the cross bar D. In the framework A A A A lies the horizontal pipe E, from the ends of which rise two vertical pipes F and G. The pipe F has a stuffing box H H, and a solid cylindrical piston I I; a supply pipe and tap J leads from a small funnel K; and lower down, projecting from the same pipe, is a discharge cock L. At the upper end of the pipe G is a stuffing box M M, through which works up and down in the pipe G the smaller pipe N N, open at both its extremities O O. On the upper end of this pipe N N is fixed and supported, by means of two vertical



rods *k k*, the chamber *a a a a*, which has a free communication with the water in the pipe N N, through the opening O; this chamber consists of two hollow cylinders *a a a a*, united at a right angle. The horizontal cylinder has an opening or communication *d d* with the perpendicular one, and is furnished at each end with a piston *b b*. The perpendicular cylinder is furnished with the piston *h h*, which answers as a moveable bottom to the whole chamber; these three pistons, *b b* and *h h*, are connected together. The piston *h h* has an opening and stuffing box at *i i*, for the pipe N N. *r r*, various stuffing boxes for the pistons *b b* and *h h*. S, a rod for communicating the power gained to machinery. T, an air cock for the admission of air during the filling and emptying of the pipes and chamber. All these pistons must move water-tight and with as little friction as possible.

I will now proceed to describe the modus operandi and the effect to be produced thereby. Water must be introduced into the pipes E F G, through the small funnel K, and through the supply cock J, until these pipes, together with the pipe N N and the chamber *a a a a*, are all completely full, the air cock T being open during the flow of water. When all are full, the supply cock J and the air cock T must be closed, and the piston I I pushed down into the pipe E; this will cause the water in the chamber *a a a a* to press upon every portion of its interior surface with a power greater than that given to the piston I I, proportionate to the difference between the area of the piston I I and the area of the chamber. Now, the moveable bottom or piston *h h* being supported by the lateral pressure on the pistons *b b*, the upper part or roof of the chamber *a a a a* is freed from a great part of the counteracting effect of the downward pressure on the moveable bottom *h h*, and, therefore, the upward pressure necessarily carries the chamber and all fixed to it upwards with a proportioned effective power, the said chamber of course descending on the upstroke of the piston I I. A power being thus obtained in the chamber *a a a a*, greater than that given to the piston I I, it is evident that if the rod S be connected by any ordinary means to a crank shaft or other suitable machinery, and the piston rod of the piston I I be moved by a suitable power, an increased production of motive power must be the result, which may be applied by any of the ordinary well-known means to machinery.

"The machine imparts a power of upward motion to the chamber *a a a a*, greater than the power applied to the prime mover or piston I I, without depending upon any escape of water from the said chamber for such effect."

1853.—WILLIAM WILLCOCKS SLEIGH [No. 809], of London, Physician and Surgeon. "The production of motive power, which he entitles 'The counteracting re-acting motive power engine.'" He says:—

"The nature of my said invention consists in producing motive power by means of water, or of any suitable fluid or liquid, acting by a forcing pump, or other well-known means, in certain chambers fixed to an axletree, the said chambers being so constructed that that portion or aspect of the pressure, force, or power, which is in the direction opposite to that in which it is intended motion should take place, is neutralized, resisted, or counteracted in such a way, and by such contrivance or apparatus, that the said re-action shall not counteract that portion or direction of the said pressure, force, or power of said fluid or liquid which is in the direction of the intended motion. The said motion not depending upon nor being produced by the exit or escape of any of said fluid or liquid from said chambers."

After describing his complex machinery, he says:—"From all which, it must be evident that when the chambers are filled with water by the pump, and force applied to its handle, the said pressure or force must produce a rotatory motion of said chambers, axletree, apparatus attached thereto, and any machinery connected by any ordinary means to said axletree." But, unfortunately for the scientific world and the public at large, said "counteracting re-action motive-power machine" has not yet been able to counteract the common inertia of matter.

1856.—WILLIAM WILLCOCKS SLEIGH [No. 404], for producing motive power, which I entitle "The hydrostatic motive-power engine."

It consists "in producing power by the action of a forcing-pump, or water contained in certain chambers fixed to an axletree, counteracting by mechanical apparatus that portion of the force or pressure which is in the direction opposite to

that in which it is intended motion should take place, said motion and counteraction not being produced by, nor depending upon, the exit or escape of any of said water from said chambers." Two folio printed pages, and a large drawing of five figures, complete the specification of this most impracticable machine.

1860.—WILLIAM WILLCOCKS SLEIGH, of 49, Middleton Square, London, M.D. "The neutralific motive-power engine."

Without any preliminary remark, the patentee commences with a description of the drawings given in four figures on two large sheets. The first contains a side view, with the frame for supporting the axle, and an immoveable ring; the second shows the axle with a longitudinal canal in its centre, forming a communication between a forcing-pump and cylinders or chambers, firmly fixed to the axle, to which guide-rods, or arms, are fixed; piston-rods support plungers in the cylinders; a forcing-pump communicates with the canal on the axle; a flat ring is fixed to and supported by the frame by brackets, to which four toothed pinions are fixed. A ring has teeth in its convex and concave surfaces, and also steps on each side of a former row of teeth. This ring is supported by and acts on a pinion. A lesser ring, with teeth on its periphery, is firmly fixed to the guide-rods or arms. Horizontal levers are attached to the piston-rods. A horizontal arm supports a cam. Legs act on the steps of a wheel (that with teeth on its convex and concave surfaces). A "circular wheel" has teeth co-operating with the teeth of the foregoing wheel, and has cams on each side to act on levers. Other levers are jointed on legs, acted on by the preceding levers, and on guide-rods or arms. There are horizontal levers to adapt the piston-rods to the bent end of the guide-rods, so bent to enable the guide-rods to pass clear in front of the before-named flat ring and the pinions.

The forces produced by water, in this instance, may be produced by a liquid or solid substance, capable of exciting two forces in opposite directions. To put the engine in action, the cylinders being full of water, force is to be applied, strong enough to sustain, and continue so to do, by repeated strokes of the pumps, till the piston of the chambers

be resisted and supported. Then motion commences! The cams before-named acting on levers, produce an action similar to that of a person on a treadmill. The pistons and their rods being thus supported and resisted, the force acting on the surface of the chambers opposite to said pistons, rotate the guide-rods, the axle, and the chambers. To stop the engine, open the tap, and let the water escape from the chambers!

The claim is for—"the principle by which the said neutralific motive-power engine acts, and which principle consists in counteracting or neutralizing one of two forces acting in opposite directions, produced by either a liquid, fluid, or solid, the force so counteracted or neutralized being in the direction opposite to that on which it is intended motion should take place; said motion not depending upon nor being produced by the exit or escape of any liquid or fluid from said chambers."

We have been thus particular in describing this "neutralific engine," because it is impossible to accompany it with an engraving, the printing of the present work being in progress during the lodging of the final specification. But what engineer, or engineer's apprentice, can require any further illustration by which to enable him to discover, whether a fluid thus bottled up in a chamber can, by means of pumps, levers, cams, and toothed pinions, be made to move machinery at all, much less so as to require to "open the tap and let the water escape" to stop it?

1846.—WILLIAM EATON [No. 11,452], of Newington, Surrey, Engineer. "Certain improvements in obtaining motive power," which consist, "in the first place, in a novel arrangement of machinery or known mechanical agents by which fluids, being subjected to pressure or force from an hydraulic press or other power applied in a suitable manner, are caused to work or operate perpetually, or so long as the parts of the said mechanical agents are in a working condition, for the purpose of actuating other machinery, as a substitute for a steam engine, water-wheel, windmill, or other first mover."

The fourteenth year for which this patent was granted having this year expired, the public should not only be in-

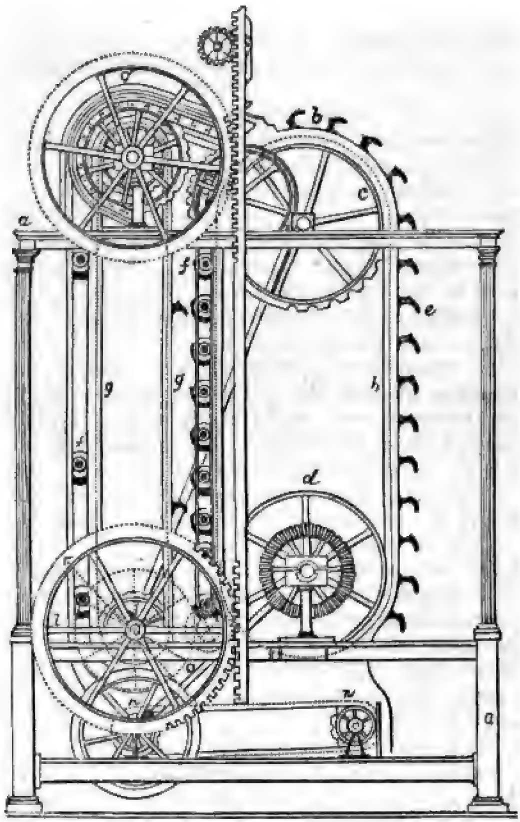
formed "that a principle heretofore not used in any engine or machinery is brought into action," and that the acting "pressure, weight, or force" is not "required to pass through space," but also that this elaborately described and illustrated invention is now public property. Let the use hereafter made of it be the test of its merit.

1848.—Joseph Eugene Asaert [No. 12,293], of Lille, France, Machinist. "Improved means of obtaining motive power."

I combine two endless chains or bands in such manner that one is caused to be moved by a series of descending weights, and thus to obtain motive power to axes, from which motion is communicated to the second endless chain or band, which is so arranged as to convey the several weights back to the higher position, and owing to there being at all times a large number of weights descending and acting at a greater leverage than there are weights ascending, and which act at a lesser leverage, there will result a considerable motive power for giving motion to other machinery.

Fig. 1, a side elevation of the machine. *a a*, the framing; *b b*, an endless chain carried by the two chain wheels *c d*. On the endless chain *b b* are fixed brackets *e e e*, which receive the weights *f f f*, as the brackets come successively over the chain wheel *c*, thus causing the chain to descend on that side of the wheel, and thus is motion obtained continuously to the wheels *c d*, according to the number and amount of weight used, and if a constant succession of these weights be delivered to the carrying brackets *e e*, on the chain *b b*, the power obtained would be the value of the several weights *f f*, which are constantly descending with the chain *b b*, but from this amount of pressure will have to be deducted the loss by reason of the friction of the various parts, and also the requisite force for causing the weights *f f* to be returned into a position for keeping up a constant supply to the chain *b b*. *g g*, a second endless chain, carried by the chain wheels *h i*, on the axes h^1 i^1, which turn in suitable bearings at h^2 i^2, and it is by means of this chain *g g* that the weights *f f* return to the upper part of the machine so as to keep up a supply to the chain *b b*, and so that that chain in descending will have all the descending brackets filled, and the leverage

by which these weights will be raised will be the radius of the wheels *h i*, which, being compared with, will be seen to be much less than the radius of the wheels *c d*, and therefore the leverage with which the weights *f f* act when descending. will be greater than that of the ascending weights. Motion is communicated to the chain *g g* in the following



manner:—On the axis c^1 is affixed a bevilled toothed wheel c^3, which takes into and drives the bevilled toothed wheel *k*

on the axis k^1, which turns in suitable bearings carried by the framing of the machine. At the lower end of the axis k^1 is affixed a bevilled toothed wheel k^2, which takes into and drives the toothed wheel l affixed to the axis i^1 of the chain wheel i. r r^1 are two toothed bars, which are so arranged as to work alternately in connection with the cog wheels on the axes h i; that is to say, when the bar r is descending, and by its weight gives motion to the axes h i, and thus aid in raising the ascending weights carried up by the chain g, the the bar r^1 being raised during the time the bar r is descending, for which purpose the bar r^1 is moved out of gear, with its cog wheels on the axes h i, then the bar r will be put out of gear with its cog wheels on the axes h i, and the bar r^1 will be brought into gear with its cog wheels and will become the descending bar, and act to give motion to the axes h i, and thus aid in raising the ascending weights, and thus will they alternately be the means of aiding in giving motion to the axes h i. The manner in which the bars r r^1 are caused to rise is as follows:—The bars are connected together in such manner, that by moving one out of gear with its cog wheels on the axes h i, will put the other bar into gear with its wheels on the axes h i, so that the bars r r^1 may alternately become descending bars, whilst the other is being raised into a position to become an acting descending bar. In raising the bars r r^1, there is a corresponding train of wheels to each bar, which receive their motion from the axis i, and the act of moving either bar r or r^1 out of action in respect to its cog wheels on the axes h i, will bring that bar into a position to be acted on by its train of wheels for raising it. s, a cog wheel on the axis i^1, which gives motion to the cog wheel s^1, which has on its axis the cog wheel s^2, which, when the bar is brought into position, raises it; and a like arrangement of wheels is used to each bar r r^1. At each end of the axis i^1 is an eccentric t, which gives motion to the lever u, and to the two bars r r^1, so that the one which has completed its descent is put in communication with its train of cog wheels, whilst the other bar r or r^1, which has completed its ascent, will be put in communication with its cog wheels on the axes h i, in order again to descend, and thus will there be a bar r or r^1 to descend, and thus aid in causing the ascending weights to be moved upwards to their highest position. By these arrangements, the supply

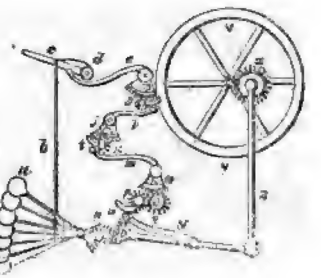
of weights *ff* will be kept up in direct ratio with the descent by the chain *b b*. And in order to ensure that the weights as they go out of use in respect to the chain *b b* may come into a correct position for the chain *g g* to take them up, the following arrangement of parts is employed:—*n n n n* are four chain wheels on the two axes n^1 n^2, and these two pair of wheels carry the two endless chains n^3 n^3, which have horns or projections n^4 at suitable intervals, so that when the weights are left successively by the brackets on the chain *b*, they will be received between these horns or projections, and moved thereby till they come into a position for the carrying brackets on the endless chain *g g*, by which the weights will be successively raised to the highest position in the machine, the ascending weights moving with greater velocity than the descending weights, and thus is the constant supply kept up to the chain *b b*. Motion is communicated to the endless chains n^3 n^3 by the axis *o*, which turns in suitable bearings carried by the framing of the machine. On the axis *o* is affixed the bevilled toothed wheel o^1, which is driven by the bevilled toothed wheel d^3 on the axis of the chain wheel *d*; and on the other end of the axis *o* is affixed the bevilled toothed wheel o^2, which takes into and drives the toothed wheel n^5 on one of the axes n^1, so that the two endless chains n^3 will be moved at such a speed as to receive and carry forward the successive weights *ff* to the chain *g g*; and in order that the weights *f* may be correctly taken forward from the chain *g*, there are two endless chains *p p* carried by four chain wheels *q q* on axes, two of which turn freely on the axis *h* of the endless chain *g g*, the other two wheels *q q* being fixed on the axes q^1, and there are horns or projections which receive the successive weights, and cause them to be moved into a correct position for the endless chain *b*, there being springs between the guides near where the weights pass into the brackets on the chain *b b*, such springs simply acting to prevent the weights passing without some force, by which they are insured being correctly delivered to the brackets of the chain *b* by the movement caused by the chains *p p*, all which will readily be understood on examining the drawings. The weights are guided in their descent, and also in their ascent, by means of the guides *x x*. In order to retard and stop the machine, a strap break is used, with other apparatus.

Having thus described my invention, what I claim is, the mode herein explained of combining mechanical parts into a machine, whereby two endless chains or bands are caused to be put in motion by a series of weights, the descending weights being at all times more numerous, and acting with greater leverage than the ascending weights, whereby an improved means of obtaining motive power is produced.

1850.—ARNAUD NICOLAS FRECHE [No. 13,220], of Paris, Merchant. "Improvements in obtaining power."

The specification occupies seven folio printed pages, and, from its peculiar language, is possibly a translation made abroad. The plan of leverage and the description are so peculiar that they are given entire:—

This invention consists in the creation of a principle of action of several levers producing by one another such a progression of power that the inventor thinks it susceptible of being applied to all the necessities which are supplied by steam. The inventor explains that the weight placed on the lever *a* will be trebled at the point which unites this lever to that marked *c*, and that this last will increase it sixfold, because it will double the power given to it by lever *a*, which will cause on the first of the multiplying levers *e* a weighing equal to six times the weight with which the lever *a* is loaded. This first multiplying lever having for point of support an axis bearing a sector, which will thus be directed by it, and the radius of this sector only being the fifth part of the length of this lever, the power given by this sector to the first multiplying lever will be five times greater, which will make it represent thirty times the weight which will load the lever *a*; but, as the cam that this sector causes to work to give a weighing on the second multiplying lever *i*, cannot be conveniently worked unless it be at some distance from the centre of the pinion which make it move, the thirty power above cited will be reduced to twelve and a half, causing the



weight which will be operated on the second multiplying lever. Now, proceeding to this second multiplying lever, and stating that by the reason that the length of its arm will contain three times the radius of the sector which it will impel, the twelve and a half power which will belong to this one will be trebled on this sector, and the power of this last will be equal to thirty-seven and a half times the weight which will load lever *a;* but as the cam which this sector will impel to make this third multiplying lever yield (marked *m*) its power as the preceding one will take place at some distance from the centre of the pinion which makes it work, these thirty-seven and a half power will be reduced to fifteen and a half, making the weight which will rest on the third multiplying lever. And, lastly, as the length of this third multiplying lever will also contain three times the radius of the sector which it will govern, and that so the fifteen and a half power which will weigh on it will be trebled on this sector, the power that the latter will have will be equal to forty-six and a half times the weight which will load the lever *a*, power which will yet be reduced by the effect of the distance from the point where the cam will work, reduction which will be, however, less than the preceding ones, because the pinion directing this cam being larger will be more powerful than the other two, from which the result will be that the forty-six and a half power will only be reduced to twenty-three and a quarter. It will thus be seen what is the progression of powers which will be given at the beginning of the operation by the simultaneous action of all these levers. That which must be next explained is the means that the inventor of this principle has imagined to overcome the obstacle which has always given to believe that it never could be attained to make a lever raise by the action of another. It is true that at the first aspect this obstacle seemed to defy all that could be tried to overcome it, since nature itself seemed to oppose it being vanquished. However, the perseverance with which the inventor sought the means of prevailing has made him find it, and this is in what these means consist:—Since, has he said, the power which a lever gives to an eccentric with the appropriation of raising another lever, cannot give fully to this eccentric the force necessary to it, so that it may operate this raising, as this power is more than absorbed by the resistance when the pressure of the eccentric takes place at a

point too distant from its centre of motion, this obstacle might, perhaps, be overcome by the creation of a system which would maintain the permanency of all the points of power. Starting from this beam of light, the inventor from that moment thought of using several levers, whose powers should be distributed at equal distances on the extent of the course the eccentric should go over, being quite persuaded that by this means the resistance occasioned by the raising of the levers which have gone over their course will not only be totally overcome, but that the power produced by these levers (which will overcome the resistance) will give besides an increase of power which will be capable of answering all necessities.

Here follow the descriptions of the different pieces which will compose each row:—*a*, principal lever, which will be charged with a relative weight according to the power to be produced. a^{I}, a^{II}, a^{III}, a^{IIII}, a^{IIIII}, point at which it is placed, each of the levers *a* of the five rows placed next that whose figure is given by the drawing, when the lever *a* is at the place shown; this explains that all the levers of this mechanism should be disposed by gradation, so that their effect may bring on the driving shaft an equal and constant power, which predominates the resistance opposed to the levers arriving at the end of their course by the levers that they raise, and thus maintains forcibly the continual impulse of the levers. The explanation just given for the levers *a* being applicable to those who depend on them, since it is the levers *a* which make them act, it is easily understood that they cannot be placed otherwise than by gradations, as are the levers *a*; this is the reason the drawing only shows the gradation of the said levers *a*. *b*, band which unites the lever *a* to that of above, to give it the power produced by the lever *a*; *c*, top lever, whose power is equal to six times the heaviness of the weight which should charge lever *a*; *d*, tail-piece, giving that power to the first multiplying lever; *e*, first multiplier; *f*, sector moved by this lever; *g*, pinion which engages with the sector *f* to move the first cam; *h*, first cam; *i*, second multiplying lever, to which this cam will give the effect of the first; *j*, sector moved by this lever; *k*, pinion which engages with this sector to move the second cam; *l*, second cam; *m*, third multiplying lever, to which this cam will give the power which the second multiplying lever will have given it; *n*, sector moved by the third multiplying lever; *o*, intermediate

wheel, whose use is to move the third cam in the proper direction; *p*, pinion which engages with this wheel to move the third cam; *q*, third cam; *r*, lever to which this cam will give the power which the preceding levers will have given. This last lever will have, similar to all the others, a roller, which will aleviate the hardness of the tail-piece and cams; *s*, crank, which will give to the driving shaft the power which will be transmitted to it by lever *r; t*, wimble, which will have two uses,—first, that of joining the crank to the driving shaft; second, that of acting by return to raise lever *a; u*, wheelwork, which will facilitate this raising by regulating it according to the course of the crank *s; v*, fly-wheel, which will maintain the progression of the pieces producing the power; *x*, gears directing this fly-wheel, which, like the said gears, will be placed in the empty space which will separate the two sides of this mechanism; *y*, driving shaft, which will be common to all the cranks, and from whence will be taken, whether on itself, or on other points by means of transmission, the power disposable; *z*, point of support of the levers and gear trees, the whole bearing on two frames, which will make for each row of levers a separate casing. Note, a hanging rod beneath the weights, which will load the levers *a*, and which will traverse two plates sliding between two grooves, will stop the working of this mechanism at will, by means of a screw threaded for the purpose, which will by these plates strongly press the hanging rod working, which will be carried out by means of a (screw threaded for the purpose, which will, by these plates, strongly press the hanging rod working, which will be carried out by means of a screw) turning handle, helped by gears if necessary, and which at the same time will disengage the fly-wheel. The upper lever, designated by the letter C, will also be loaded with a weight if thought fit, so as to have to place on the lever *a* a heavy load. In order that the cogs of the gears may constantly adhere, so that the coming and going that the levers operate may not cause any loss of time, springs or balance weights will be used, which, being fixed to the axes of these gears, will oblige their cogs to remain always applied to each other. The inventor thinks that this addition of levers would deliver this mechanism from the inconvenience of the dead points which the wimbles cause by the position they take in their revolutions. He, moreover, thinks that by these levers

more power still would be gained; but this advantage would be at the expense of the velocity. As to the first motion which the cams would prevent being regular, it would be remedied by arranging the arm of the levers joined to the cranks, so as to give to the driving shaft an invariable motion, whatever be the action of these cams on the levers which impel the driving shaft.

1851.—GUSTAV ADOLPH BUCHHOLZ [No. 13,515], of Norfolk Street, London, Civil Engineer. "Improvements in motive power, and in propulsion." This is a specification in eleven printed folio pages, with seventeen sheets of drawings, containing thirty-nine figures. The third part of his invention consists "in a machine constructed of such mechanical parts, that, constant pressure being applied at two or more points, and so that the lines of pressure shall give rotary motion to one or more axes, the pressure shall remain stationary in position." At page 6 of this singular document, he says:—"I will now proceed to describe certain modes of applying constant force of pressure to the eccentrics, to produce the desired motion." He thus begins:—"A is the framework of the machine, which is securely bolted and fixed together. B*, a 'bush,' through which the screw C* works for compressing the spring D*, pressing upon the rods E*, E*," and so forth. And we are assured—"this machine will be found to work more advantageously when the forces are applied to the eccentrics in a direction as nearly as possible at right angles to a line passing through the centres of the two systems of eccentrics." Again,—"Drawing 8 shews another simple machine," in which "pressure upon the eccentrics will produce a continuous rotary motion of the shaft A." He then gives his views on obtaining compound motion.

1852.—THOMAS GREAVES [No. 283], of Manchester, Veterinary Surgeon. "Improvements in the method or means of obtaining or employing motive power." "This machine consists of a beam about six feet long, affixed upon a frame; at one end of the beam are two connecting rods, one attached to a crank, the other to a rod over a hopper."

A flat chain, large pulley, buckets, &c., follow; yet, in spite of all, "this machine will dispense entirely and altogether with either steam power or manual labour!" Believe it who can.

1855.—THOMAS GREAVES [No. 2205]. In October, 1855, he commenced, but did not complete, a patent for improvements on above. I now propose (he says) to have only one shaft to run through the beam, and also through two large bevil wheels, the beam being placed between the said wheels, one end forming a shaft for two pinions of different sizes rivetted together, which gear into the bevil wheels, each having two half rims, one forming an inner or lesser circle, having teeth of the same pitch, gearing into one of the pinions, *et cætera*, and *et cætera!*.

1852.—LOT FAULKNER [No. 410], of Cheadle, Chester, Machinist. "Certain improvements in the method of obtaining motive power."

"I employ a beam capable of vibrating upon a fixed centre; to one end I attach the machinery to be moved; to the other, two levers mounted upon studs, and so connected by spur gearing that they shall revolve in opposite directions, and always counterbalance each other; and upon these levers I place suitable weights." And so on. In conclusion, "As the power required to put the weighted levers in motion is so small in comparison with the force exerted at the other end of the vibrating beam, it will be evident that a great increasing motive power is obtained." This being only a provisional specification, so far makes the supposed invention public and free.

1852.—ERNST LUEDEKE [No. 706], of Bedford Street, London. "Improvements in obtaining and applying motive power." "I intend, by the use of a pendulum, double wheel, and springs, to produce vibration, kept up by the concurrent action of the pendulum," &c. Only provisional, and therefore now public property.

1852.—THOMAS WOOD [No. 887], of the Glue Works, Hunslet, Leeds, Millwright. "Improvements in the mode of obtaining motive power." "My invention consists (he says) in obtaining motive power by means of a wheel, the periphery of which presses on water, or any other fluid, confined within a box or case, or larger wheel, to which, backward and forward, or rotatory, motion is communicated by mechanical means." He adds:—"In combination with this wheel and water chamber, I employ weights, which are made alternately to rise and fall, and by means of levers and suitable gearing to act upon the wheel." A good drawing of this notable machine accompanies the specification.

1852.—GEORGE FITT [No. 921], of Parsonage House, Chalk, near Gravesend. "Obtaining mechanical motive power and speed." This is a singular specification, although only provisional, and has a large drawing attached. Its author has now lost all title to the invention. He says:—"From the mechanical principle of the inclined plane, and a certain law of the lever, I have produced, by an arrangement of machinery, a multiplied mechanical force without an ultimate loss of speed." He adds:—"The method of working the machine is, by causing the power to revert to the first wedge from any part where it is greater and the velocity is the same as in the first wedge, by the bands and riggers, *i. e.*, by rods, or any other method, by the hand or by a spring, or anything else capable of giving it motion and force." Again:—"Suffice it to say, that by increasing the diameter of the wedges, and the velocity with which they revolve, and the number acting on each other, a power can be obtained more than sufficient for any purpose yet known, or that ever will be known, where power is required."

1852.—A. V. NEWTON [No. 1163], of Chancery Lane, London, Patent Agent. "Improvements in obtaining and applying motive power." This invention consists in "employing the pressure of a weight or of a lever, to act upon one or more wheels, rollers, or pulleys, and thereby cause them, by their rotation, to actuate the axle or shaft intended

to communicate motion to a carriage or machine." Eight and a half folio pages of description follow, with two large sheets of drawings, as given by this agent's "foreign correspondent," who states that—"The principle upon which is based the present invention is, that the force of gravity properly applied will produce the effect of a horizontal or tractive force. This being the case, it will be understood that, by properly applying and adapting this force of gravity, a carriage, even when loaded with a heavy weight, may, or to a certain extent, be made to propel itself."

1852.—BENJAMIN GLORNEY [No. 1189], of Mardlyke Mills, near Dublin, Manufacturer. "Improvements in obtaining and applying motive power." He has only filed a provisional specification, which, if it has no other merit, has that of brevity. He says:—"This invention consists in obtaining motive power by the weight of a moving waggon or carriage, which is made to traverse backwards and forwards along a railway, and thereby communicate thereto an oscillating or vibrating motion, or a rectilinear motion, the said railway being either mounted on a centre or pivot for this purpose, or otherwise constructed and arranged so that the weight of the loaded waggon or carriage may be made to act thereon. The power and motion thus obtained may be communicated by any convenient gearing to the machinery intended to be driven; but the peculiar arrangement of such gearing must depend upon circumstances, and should, in a great measure, be left to the discrimination of a competent engineer."

1853.—AUGUSTE E. L. BELLFORD [No. 118], of Castle Street, London, Patent Agent. "An improved machine for obtaining motive power." It is "composed of pumps of small diameter, a water reservoir into which air is pumped, causing the water to escape by a tube, thence into a smaller cylinder," &c., &c. Suffice it to say, that this complication of pumps, pipes, and cisterns, is so efficient, "that once in movement, the machine will feel it, and will not require any auxillary motive power." As the plan (communicated by a

foreigner) is fully described by drawings, although the patent is not completed, it is open to public use—if wanted.

1854.—ADDERLEY WILLCOCKS SLEIGH [No. 174], Knight of the Most Noble and Ancient Order of the Tower and Sword, M.R.H.S., Captain Royal Services of Portugal and Spain, late R.N., of No. 1, Weymouth Street, Portland Place, London, Middlesex, for his invention of "creating a continual self-acting, self-sustaining, new motive power, applicable to every purpose requiring speed, motion, and power, together or separately."

He states as his invention,—"Firstly, The application, by the mechanical agency hereinafter described, of the principle of the imponderosity or identification of lesser quantities or bodies of fluids, or liquids in fluids, or liquids of their own nature, or otherwise, and of the same or different temperatures. Secondly, Of the principle of the ponderosity, attraction, or specific gravity and momentum of fluids or liquids in the atmosphere, or in any less dense medium, or in a vacuum." And so through four other heads of like jargon. He concludes:—"I do not confine my discovery and invention, the principles being natural laws; and being the first and only person to shew and ascertain and prove (?) how those natural laws could be applied to power and speed by an engine invented by me, and these principles thus applied being correct."

In the printed specification, six folio pages are occupied with description, and two large but extraordinarily-executed drawings given, they being mere rough pen-and-ink hand sketches, executed without rule or compasses. A more stubbornly solid piece of mechanical invention it is next to impossible to imagine; and only that, according to his own statements, the patentee himself appears so satisfied with its versatile mobility, we might good-naturedly enough suppose his sole object was to solicit information on the merits of this oddly conceived and constructed monster perpetual motion engine.

1854.—JOHN AITKEN [No. 557], of Longsight, Manchester,

Gentleman. "Improvements in obtaining motive power." His short provisional specification, all he published, makes the following a public gift!—"This invention consists in an arrangement of apparatus for obtaining power by lifting and lowering weights, and this is done by means of two pulleys between which are guides for the weights used. The lowest of the two pulleys is so formed as to push the weights in succession up the guide to the upper pulley, over which it passes, and descends by the guide on the opposite side. The machine is set in motion by any external power, and then the principles of inertia, gravity, and momentum are brought into action, and the result is, the weight of the balls falling, and their momentum is on one side of the working wheel, the cog wheel, and on the other side the weight of the ascending balls lessened by their momentum; the momentum in both being in proportion to their velocity, and the difference between the two is the working power." Possibly he has often since wished that facts had favoured him as much as a fervid fancy in making such a declaration of his supposed invention.

1854.—James W. Shaw [No. 1360], of Birmingham, Merchant. A communication from Don Manuel Maria José Trinidad Miciano y Contillo, residing at Cadiz, Spain "Improvements in apparatus or machinery for producing motive power." This ingenious Spaniard saith:—"The invention consists in a certain arrangement and combination of an axle with a system of shifting radial arms or levers, furnished with weights, and maintaining a motive power by the force of gravity alone, without any other agent than mechanism."

1854.—Plato Oulton [No. 1744], of Dublin. Gentleman. "Improvements in obtaining motive power." "My invention consists in the construction of a machine or apparatus in which a stream of leaden or other suitable balls are made to supply the place of water in actuating two or more main wheels, and in which provision is made for keeping up a constant supply or stream of balls to these wheels by means of a peculiar arrangement of worm shafts." The machine consists of "two main wheels, above which is an inclined

plane, by way of head race, down which the balls roll on to the wheels, each ball entering one of the buckets of the wheels. When the balls have carried the wheels round, they fall on to and roll down another short inclined plane, by way of tail race, and are carried on to the screws or worm shafts." This "head race" and "tail race" must, long ere this, have turned out a goose chase. The whole specification reads as if rather coming from the good old times of the last century than with the freshness of only the last six years. Three and a half folio pages of print, and a large drawing, complete this sapient specification.

1854.—Frederick Samson Thomas [No. 2129], of 17, Cornhill, London. "An improved mode of obtaining motive power." Provisional protection alone having been obtained, expired within six months, and the following statement is now given to the public for whatever it is worth:—"My invention (he says) consists in certain mechanical contrivances for the construction of a wheel having, by its own mechanical construction, the power to commence and sustain a rotative movement, and applicable to convey such movement to other machinery requiring motive power. The construction of the wheel consists in forming therein certain arms or chambers, upon or within which I place weighty balls, or rollers, or fluids, which approach the periphery of the wheel upon the descending side, and the centre or nave of the wheel upon the ascending side; and by the greater leverage on the descending side, I provide the power by which the wheel obtains and sustains its own rotative movement."

The early pages of the present volume sufficiently expose the fallacy of this oft-repeated scheme.

1854.—George Hale [No. 2589], of Tavistock Street, London, Boot and Shoe Maker. "Certain improvements in obtaining and applying motive power." Although only provisionally specified, and therefore lost to the patentee, the public will be no gainers, the invention being a very old one. "My improvements (?) consist in taking advantage of the

power of gravity, and applying the same by means of a suitable arrangement of mechanical parts to drive machinery of various kinds. Power is obtained (?) by causing certain weights applied to or connected with rotating arms or levers to act upon and drive a central shaft with which the said arms are connected. The weighted levers are jointed, and so arranged, that when they are intended to act by their gravity on the shaft to be driven, they will be extended outwards to their greatest extent, so that their weights may be made to act with the greatest leverage and effect on the central shaft, and cause the same to rotate; and when the weighted arms or levers have so acted, and are required to be brought up again into their elevated position, the weights are brought nearer to the centre of the shaft, or of the circle of rotation, so as to diminish the leverage and allow the falling weights, whose leverage is much greater, to overcome the gravity of the ascending ones. The motive power thus obtained may be applied by causing the motion of the centre shaft to be communicated to the main driving shaft of any machine or apparatus required to be driven." Alas! who, reading the above, would suppose he was perusing a document from the archives of the Patent Office?

1855.—Jacques Roux Delguey Malavas [No. 238], of Montbrison, France, Gentleman. "Improved machinery for obtaining and applying motive power." It consists of "an arrangement of apparatus which I term (he says) gravitation machinery." Its principle "is founded upon the laws of gravity, and the power depends upon the difference which exists with the same weight, according to whether it is brought nearer to or further from its point of gravitation."

"The apparatus consists of a number of circular plates accurately fixed on a long horizontal shaft mounted in suitable bearings. Between these plates are placed long levers, their centres of motion at one end, their opposite ends resting in guides, &c."

He concludes:—"When the main shaft has been made to rotate once, the weight of the levers, by bearing on the discs, will keep it continuously in motion." A large drawing, and four and a half folio printed pages, complete the specification of this not very obvious scheme.

1855.—George Augustus Huddart [No. 942], of Brynkir, Caernarvon. "Improved machinery for obtaining and applying motive power." A water-wheel with buckets, and a chain of buckets; the first to raise the water to an elevated cistern, being rotated by the chain, operated by the discharge of the water raised. Why disturb such novelties from their original dust? But, above all, why attempt patenting such rubbish?

1860.—George Augustus Huddart and Joseph Durham Erskine Huddart [No. 263], both of Brynkir, Caernarvon, Gentlemen. "Improvements in obtaining motive power."

The object of this invention is to obtain motive power by loading a wheel in such a manner that the specific gravity of the load on one side shall always exceed that of the other, and thereby ensure its continuous rotation so long as the mechanism is desired to operate. The load proposed to be applied to the wheel may consist, for example, of a series of cylinders open at one end, and fitted each with a weighted piston, which closes them air-tight. The cylinders are placed around the wheel, and the whole of the apparatus is to be immersed in water or other liquid. The cylinders are to be filled with air or other aeriform body, and the weighted pistons, as they come round to the position for pressing upon the air or gas contained in their respective cylinders, will compress that fluid, and thus the buoyancy of the cylinder will be proportionately reduced. When, however, the weighted piston becomes pendent, it will act in the opposite direction, and expand the confined air or gas, and thereby increase the buoyancy of its cylinder; thus each cylinder will be constantly presenting to the central wheel a varying specific gravity. And it is this increase or decrease in the specific gravity of the parts forming the load which is made available for driving the wheel, and thereby producing motive power.

Instead of employing a dead weight for compressing and expanding the confined air, a cam or other equivalent mechanical means may be adopted. The load may also, if preferred, be carried by an endless chain passing over a pair of chain wheels.

1855.—Robert Benton [No. 2304], of Birmingham, Engineer, Surveyor, and Land Agent. "Improvements in obtaining motive power by leverage."

This invention has for its object the means of keeping a barrel or wheel in continuous motion by the successive application of any even number of levers, acting entirely independent of each other, and in eccentric instead of the customary circular orbits; for which purpose, eccentric planes are employed, and each lever, on successively coming in contact with such eccentric plane or planes, is for the time being elongated, and rendered a long lever with a short shank; and having passed through or over such plane or planes, it immediately becomes neutralized on the rising side of the barrel or wheel to which it is attached, by being so fixed as to form one side of a cube figure, either square or octagonal, and in that position it is carried round the moving barrel or wheel until its pivot returns to the point from whence it was first placed against the face of the eccentric plane.

The patentee had arrived at an advanced age at the above date, which, coupled with his experience and earnest belief in the truthfulness of his scheme, might well plead an ample apology for the wilder non-perpetualities of mere tyros in mechanical science.

1855.—Henry Weber [No. 2373], of Zurich, Switzerland, Mechanician. "Certain improvements in apparatus for motive power."

"My apparatus (he says) consists of a half cylinder (which may be made to rotate on a centre), placed in an inclined position, and supported on drums or friction rollers, on which it travels in circular guides. To the upper part of the half cylinder is attached a weight in such a manner as to press by means of a lever on its upper edge. The weight pressing on the half cylinder imparts to it a continued revolving motion in the guide circles."

1855.—Michel Pierre Gilardeau [No. 2607], of Paris, and 4, South Street, Finsbury, London. "A new motive power." "The invention consists, first, in using a certain quantity of liquid equal to a weight of at least three atmo-

spheres, to compress the air alternately into two parallel pumps, thereby obtaining a power equal to the weight employed. Secondly, to make use of the compressed air for propelling a horizontal cylinder in which a vacuum is produced. And, lastly, to compel the weight employed for compressing the air to pass from one side of the apparatus to the other."

1856.—DAVID JONES [No. 463], of Ragland, Monmouth, Civil Engineer. "Certain improvements in obtaining and applying motive power." This invention consists in obtaining power by the combined action of air, water, or other fluids on each other, by vacuum or pressure. An important feature consists in so constructing and operating with the apparatus that there is no appreciable friction of the principal parts thereof, and consequently no wear of the material, thereby effecting economy; the power generated and maintained in the apparatus for an indefinite period is also attended with no expense.

I take (he adds) an open vessel, of any convenient shape or size, into which I place water; also a cylindrical vessel, the air discharged therefrom, is to be filled with water, and placed upright with the open end downwards, immersed in the first vessel; a hollow collapsible sphere has affixed to one end a flexible tube, formed with two outlets or branches, each fitted with a cock, one opening to the atmosphere, the other to a hollow vessel.

A "vibrating lever" is described; and after a printed page of description, we are at last assured that—"The alternate opening and closing of the cocks of the apparatus is rendered self-acting by the vibrating movement of the lever or other suitable means."

Most likely the "other suitable means" was found, in the end, to be just the one thing wanting, for this patent, like many of its class, never went beyond the first six months' protection.

1856.—WILLIAM SMITH [No. 1158], Adelphi, London. A communication from Alexandre Herault, of Angers, France. "A new application of the syphon as an irrigator and a motive power machine."

The invention consists in the peculiar arrangement of an apparatus fitted to the upper part of a syphon, which is provided with receptacles, which permit the withdrawal of a certain quantity of water from it without disturbing it or its action. and employing this water at the same time as a motive power, by the means and through the instrumentality of the apparatus itself, and also by its fall working an hydraulic power of any description, or feeding a system of irrigation. Finally, by means of this apparatus, water can be thrown to a height of from three to seven or eight yards, without cessation, by making the exit vent of the trough in a proportion agreeing to the quantity or volume of water that it receives.

Two folio pages of print and a full drawing complete the specification of this topsy-turvy syphon; but as the invention did not proceed to the Great Seal, all right in it has lapsed in consequence. The idea is by no means new, and its cause of failure is due to an imperative law of hydrostatics.

1856.—Duncan Lang [No. 1345], of Greenock, Scotland, Engineer. "Improvements in obtaining and applying motive power."

Air (he says), when accumulated in any vessel, and compressed or urged into motion, acts as a very powerful motive agent.

Having described an engine, but one that is capable of great modification, he concludes:—"The motion is perpetual in its action, in as far as matter or material is susceptible of the time (query, "term") being applied to mechanical invention, and capable of being modified and adjusted, stopped and resumed. Its advantages are—its enormous power and economical use; the pressure from the compressed air of the common atmosphere dispensing with coal, coke, fire, and the tear and wear of their action, and expense, as attendant on the engines of the present day in their practical working."

That word "practical" is a decidedly saving clause in this instance. But who would not rather bear with the wear and tear of expensive machinery steam-propelled, than rest satisfied with the much-extolled machinery here and elsewhere described as that of which "the motion is perpetual?"

1856.—General Henri Dembinski [No. 1611], of Paris.

"An apparatus giving a self-acting motive power, produced by water, elasticity, compressed water, or any gas whatever."

My invention (he says) consists of an apparatus to produce a continual motion reproductive of itself, by two wheels being connected by means of gearing or endless chains or ropes, the motion being produced either by weight or elasticity, the latter obtained by air, gas, compressed water, or any compressible fluid.

This hopeless scheme is accompanied by a drawing described in a full folio page of letter-press, presenting no extractable point of interest. It never had more than six months' patent protection.

1856.—ROBERT and EDWARD LAVENDER [No. 2164], of London. "Improvements in raising water and other fluids, and in obtaining power thereby." Their apparatus consists of two upright cylinders, between and over which a wheel or pulley is mounted, and over this wheel an articulated piston is hung, its ends passing into the two cylinders; one end of the piston descending into one of the cylinders, displaces the fluid therein, which flows up to suitable troughs, and the other end of the piston descends into the other cylinder. Hydraulic bellows are recommended for giving motive power! "In this way (we are assured) any amount of motive power will be obtained, and the only cost thereof will be that of keeping the machinery in repair." Which "cost," we can promise, shall be as nothing per annum, for how can that wear out that remains so imperturbably quiet?

1856.—ANTIONE JEAN BAPTISTE LESPINASSE [No. 2234], of Toulouse, France, Engineer. "Improvements in the means of obtaining motive power." All we can learn of this precious scheme is derived from one of the shortest possible provisional specifications, thus:—"This invention relates to an improved hydraulic apparatus for obtaining motive power. This apparatus consists of a reservoir of water, or other fluid, fitted with a syphon, the larger limb of which passes down to a water wheel, and is so constructed as to be capable of directing a stream of water on to either side of the wheel,

according to the direction of rotation required. The axis of this wheel works a set of pumps for raising the water which has acted upon the wheel, and returning it to the reservoir to be again supplied to the wheel through the syphon. The power may be transmitted from the axis of the water-wheel to a driving shaft in any convenient manner."

1856.—ROBERT GEORGE BARROW [No. 2455], of Poplar, London, Engineer. "A self-maintaining motive power obtained from water, air, or any other fluid or liquid." He says:—"The method of obtaining motive power, self-sustaining, is as follows: I make a double-acting force-pump of one half the diameter of the cylinder, and attach to it a receiver with an hemispherical top (air-tight), and I force water or air into this receiver with the pump until I attain the pressure on the square inch required. I then attach or connect the pump to the engine, and it will maintain the supply in the receiver for any definite period required, so long as all the joints are tight and in working order." A complete specification and drawings were filed by the inventor's executors, but the character of the invention, as a "self-sustaining" power, is by no means clear.

1856.—AIMÉ LECOCQ [No. 2873], of France, Contractor. "Improvements in hydraulic engines." These improvements consist in an arrangement by which the pressure of the water flowing from a basin or reservoir, and falling down in the buckets of a wheel enclosed on both sides, causes this wheel to turn and carry the water up through a syphon-like canal to another basin or reservoir, from whence part of the water may flow and impart motion to another wheel, which latter, as well as the first one, may serve then as a prime mover for any machinery.

1857.—BARTHOLOMEW PREDAVALLE [No. 958], of Bloomsbury, London, Civil Engineer. "A new motive engine." "The said invention (he says) consists in the action, alternately intercepted and restored, of the vertical pressure

of liquids on a base, and the ascent of liquids by capillary attraction. For this purpose, twice the liquid, for instance, water, wanted to rise a piston in a cylinder is put in a vessel, large in size and small in depth, communicating with the said cylinder. A reservoir above the vessel, and of the same size, is put in communicatlon with the cover of the vessel by a pipe, and both the reservoir and pipe are filled with water. In the cover of the vessel there are fixed some capillary tubes in glass, communicating with the water inside the vessel, and such in number as to contain about the quantity of water required to raise the piston, these capillary tubes passing throughout the bottom of the reservoir into the water; they are vertical for about one inch, then horizontal for about half an inch, then vertical to the top. This particular construction of the capillary tubes is indispensable to the purpose for which they are intended. A valve in the cover of the vessel when cut off the communication of the pipe with the water in the vessel, opens the communication between the water in the vessel and the capillary tubes." He also vaguely describes another similar machine, being only a provisional specification.

1858.—BARTOLOMMEO PREDAVALLE [No. 2563], of Hart Street, Middlesex, Civil Engineer. "Improvements in producing or obtaining motive power."

"My invention relates to the combination of certain mechanical means in connection with a peculiar property of fluids observable in the 'hydrostatic paradox' for the purpose of producing or obtaining motive power. According to this invention, motive power is produced by the vertical pressure of a column of fluid alternately cut off and restored. For this purpose, a column of fluid is caused to exert vertical pressure on a body of fluid contained in a vessel of larger base than the diameter of the column, means being provided for alternately and instantaneously cutting off and restoring such pressure for neutralizing the pressure on the side opposite to that on which motion is to be primarily produced, and for returning the vessel after having been acted on to its original position to receive a fresh impulse. I include in the term 'fluid,' and propose to use as the fluid agent, water or other liquid, mercury or other substance kept naturally or

artificially in a state of sufficient fluidity, vapours, gaseous or aeriform fluids. In one arrangement, I employ a vessel consisting of two separate parts (kept in contact), and fix vertically thereto a pipe or tube which communicates with the interior of the vessel, and which I fill with fluid so as to obtain a pressure in the vessel equal to the weight of a column having the diameter of the vessel's interior and the height of the pipe. The bottom of the vessel is connected by a shaft, or otherwise, to one end of a beam or lever, to the other end of which, and at an equal distance from the centre, is connected another apparatus (or pipe and vessel) in every respect similar to the preceding. To each pipe, near its junction with its respective vessel, is fitted a cock or valve, which cocks or valves may be acted on by the motion of the machine itself, and are so arranged as to open and shut alternately, so that when one is open, the column of fluid will instantly act on the vessel in connection with it, and by its pressure force it down, and with it the end of the beam; while the other vessel, having its cock or valve shut, has no other pressure than its own absolute weight, and is consequently raised by the leverage of the balance, *i. e.*, the depression of the descending vessel. The action is then reversed, and thus a reciprocating motion is produced by the vertical pressure of the column of fluid alternately cut off and restored. Motion thus obtained may be applied directly or transmitted vertically, horizontally, or obliquely, or converted into rotary or other motion by suitable appliances. The power so obtained may also be caused to compress liquids or steam, or other aeriform or gaseous fluid, in a separate vessel, in order to drive pistons or communicate motion to an Archimedean screw, wheels, or other contrivances, and may be adopted in substitution of steam, water power, or other agent, for working any known arrangement of engine."

1859.—BARTOLOMMEO PREDAVALLE [No. 2851], of Bloomsbury Street, London, Civil Engineer. "According to this invention, motive power is produced by the vertical pressure of a column of fluid alternately changing its action on the beam of a balance." Only provisional protection was obtained.

1860.—Bartolommeo Predavalle [No. 1458], of Bloomsbury, London, Civil Engineer. "A new mode of, and apparatus for producing and obtaining, motive power."

The provisional specification (all published) states:—"My invention consists in a constant atmospheric pressure imparting its downward gravitation on a vertical column of liquid, communicating with a hollow piston suspended in a cylinder and surrounded by a vacuum. At one extremity of an india-rubber tube is fixed a circular frame containing a valve opening outside, and at about an inch from this a plate of the same diameter as the valve is secured, in order to form a kind of a hollow air-tight piston sack or bag."

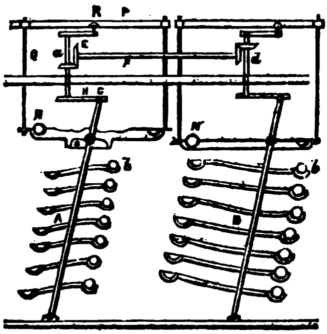
More surely need not be quoted to convince any one of the impossibility of effecting a moving power by such an arrangement. However, one more quotation will suffice:—"When the vacuum is made in the cylinder, and the vertical pipe filled with liquid, the pressure of the atmosphere through the thin or small pipe will impart a constant impulsive force to the valve and to the rod touching it, in proportion to the height of the column of liquid and the vacuum produced; and the apparatus will move according to the adopted contrivance, and may be applied as the piston of a steam-engine."

1857.—Charles Barlow [No. 1108], of Chancery Lane, London, Patent Agent. A communication by Joseph Commandeur, of Lyons, France, Gentleman. "A mechanical apparatus for regenerating the impulsive force of any motive power." He says:—

The effects of this machine are due to the force created by the travelling of heavy iron balls or weights in and around helical spirals, which are wound round cylinders of different diameters. These cylinders are set in motion by the impulse given to them by the gravitation of the heavy weights or balls when set in motion, which motion is of an oscillating rotatory kind, on account of the shafts being inclined.

The drawing represents a vertical section across the axle of the upright cylinders A and B. The helical spirals are of a hollow or trough form, so that the iron balls or weights placed at the upper end will easily and instantly run down them. The spirals of the cylinders A and B have a reverse

action—the former acts as the motive power, the latter as a resistance; that is to say, its only purpose is to carry up again the balls or weights running out from the lower spirals of the cylinder A into a lower horizontal trough C, which conveys them into a lower spire of the cylinder B, the iron balls running up the said cylinder through the spiral windings until they reach the top part, where they fall into the horizontal path D, which conveys them back to the upper spirals of the cylinder B by means of the four bevilled wheels E E E E, two of which are keyed to the horizontal shaft F,



and the two others on short vertical shafts A and D. The number of spirals being the same in each cylinder, and their rotative motion being at the same speed, it follows that at each revolution of the cylinder A a ball will run out of the lower spiral, and will be conveyed back to the cylinder B through the straight trough, and similarly at each revolution of the cylinder B a ball will run out of its upper spiral and be conveyed back into the cylinder A through the gutter or trough D. This new combination will constantly regenerate and maintain the first impulsive force applied to the apparatus. From the disposition of the helical spirals and cylinders, it is evident that the surfaces of revolution generated by the axes or shafts T T, of the cylinders A and B, are conical surfaces, the generating lines of which are the axes I I of the cylinders, which revolve around their summit,

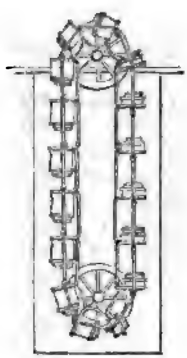
which moving freely in suitable bearings, the axles or shafts I I can revolve very freely. The top part of the shafts I I is also of a spheroidal shape, as seen at G G, and, working in brass seats, moves freely at top and bottom in its bearings, so that the motion of the shafts is easy, the first driving around with it the crank H, whilst the shaft I is driven by the crank H. At the lower part of the cylinders, discs J J are keyed, which discs are provided with wedge pieces K K, the lower corners of which bear on the chairs L L for the purpose of lessening the strain at the end of the cranks, producing a kind of re-action which acts as an addition to the motive force. Above the cylinders A and B, circular plates or troughs are placed, working on brass bearings around the rounded edges of the shafts I I. In these troughs, heavy iron balls travel, serving as a fly-wheel to the rest of the machine, and balancing the balls in the spirals. These plates have an oscillating motion on the rounded edges O O, and are connected to the upper cross arm plates P P by rods Q Q Q Q. They have also an oscillatory motion given to them by the crank knobs R R. The troughed plates M M ought to have an inverted inclination to that of the helical spires of the cylinder, which inclination may be suitably regulated by the screw nuts on the connecting rods Q Q Q Q, as shown on the drawing. The under sides of the troughed plate are provided with a circular rib S S, projecting downwards, and rounded off at its edge, and which constantly bears on the plates T T as they revolve. By means of the adjustable connecting rods Q Q Q Q, the heavy balls N N are started, running to the required number in advance of the cylinders, so as to overcome the dead points. By means of the apparatus hereinbefore described, and shown by the annexed drawing, impulsive force may be increased by increasing the number of spirals so as to admit of the use of more weights, or by enlarging the pitch of the helical so as to admit of the use of larger balls; and some of these balls might be hollow, so as to increase power in the less ratio. Instead of the helical cylinder A, a bucket-wheel might be used, into which the balls carried up by the spirals of the cylinder B would enter at its top part. The contrary principle might be applied, videlicet, the helical cylinder A might be preserved as the motive agent, and the wheel to carry the balls. Lastly, both helical cylinders might be applied to

convey the iron balls to the wheel, which latter should then be the motive agent. The force and efficacy of the apparatus will increase or decrease according to the size and weight of the balls, to the diameter of the motive helical spiral, and to the weight of the balls in the troughed plate.

I claim the construction of a machine for imparting motive power actuated by rotating balls in helical spirals, or any mere equivalents therefor.

1857.—Peter Armand le Comte de Fontainemoreau [No. 1330], of London, Agent. "An improved hydraulic motor." A communication.

The apparatus is composed of a number of hollow elastic buckets or bellows, partly immersed in water, made to pass over two pulleys. Each bellows is furnished with a leaden weight at the bottom, which forces the air contained in the bellows on one side, to pass by means of connecting tubes into those buckets or bellows which are on the opposite side. The bellows are fitted to slotted links, and connected together so as to form an endless chain, which passes over the two pulleys.



1857.—William Gilmour [No. 2125], of Dalbeth, Scotland. "Improvements in obtaining motive power."

This invention (he says) relates to the obtainment of a continuously-acting motive power, by means of weights operating upon combinations of levers or parts acting on the lever principle. It may be carried out under various practical forms, but under one of its simplest modifications the apparatus mainly consists of a pair of long parallel horizontal levers of the first order, each set upon a fulcrum near one end, whilst to the other and longer end there is hung a weight of a certain predetermined size. The descent of this weight,

when the apparatus is in motion, obviously elevates the opposite shorter arm of the lever, and this end is connected to a short crank upon a small horizontal shaft, which shaft has upon its opposite end a longer crank.

The pin of this longer crank is jointed by a suitable link to the longer arm of another lever of half the length of the main lever. This lever is also of the first order, and its shorter arm is linked to one end of an equal-armed lever, the opposite end of which lever is connected by a rod to a crank upon a long horizontal transverse shaft. This long shaft has upon it three other cranks; the second of these cranks is linked to the longer arm of another lever, to which is hung a weighted lever one half that of the weight on the main lever. The other shorter end of this lever is linked to one end of an equal-armed lever, the opposite end of which is linked to a crank on a secondary horizontal transverse shaft. This shaft has also four cranks upon it, and the external one next to that last referred to is linked to the weighted end of the main horizontal lever.

The remaining two cranks on the main horizontal four-cranked shaft operate in a precisely similar manner upon an exactly corresponding series of parts in connection with the other main horizontal lever; in other words, the arrangement comprehends two main horizontal weighted levers, working in combination through the intervention of precisely similar parts, the entire apparatus comprising four acting weights, the two on the main levers being twice the weight of the other two.

The result of this combination is, that as the two main weighted levers descend, they alternately elevate the other lighter weights, which lighter weights in turn descending, operate by means of their lever connections so as to again raise the main weighted levers, and thus cause the main horizontal crank shaft continuously to revolve.

1857.—William Middleship [No. 3199], of South Grove, Mile End, London, of H. M. Customs. "Improved machinery or apparatus for obtaining motive power."

My invention of improved machinery or apparatus for obtaining motive power consists principally of a wheel of any

suitable diameter, and mounted on a spindle which turns in bearings; the rotation of this wheel is to be effected and kept up by maintaining a weight of water always on one side of the wheel, or if the wheel should be immersed in water, the same object may be effected by the inflation of chambers with air, the ascending power of the air chambers being sufficient to communicate rotating power to the wheel, as the air chambers will be inflated on one side only of the wheel. Whether water or air be employed as the motive agent, the chambers, which must be arranged round the periphery of the wheel, must be collapsible, so as to admit of their alternately receiving the air or water, and allowing the same to be expelled when required. I prefer to make the chambers in the form of a wedge, but other forms may be employed if preferred.

As respects working the wheel by water power, on the right hand of the wheel the collapsible chambers are filled with water, and as they communicate by means of tubes with similar chambers on the opposite side of the wheel, it will be understood that when the wheel begins to rotate, in consequence of the weight of water on one side of it, the collapsible vessels which are capable of compression are brought into contact with a pressing wheel mounted in bearings below the water wheel. The pressing wheel is moved by the friction of contact only, and the collapsible chambers being pressed between the two wheels, the water is forced out of the lower ends up into the opposite chamber above, thus rendering the weight on the opposite side of the wheel the same as before the movement took place; the emptied chamber is prevented from filling again until it arrives at the top, and is ready to pass to the right side of the axis. The motion is continued by each chamber being successively brought down and compressed, and the water therefrom forced into the opposite chamber above in regular succession. The reflow of water from the upper into the lower chamber, after passing the point of compression, is to be prevented by a button turned by a pin, or any other suitable contrivance, which must be brought into operation just as the chamber is emptied. The button or other contrivance which closes the collapsible chambers may be removed by a similar pin when the chamber reaches the upper part of the wheel to be refilled. Assuming that the

weight of ten pounds of water on the right side of the wheel would be sufficient to force up one pound to the required opposite point, any additional number of chambers for which there might be space left would give an increased motive power.

The principle, when applied to air working a wheel under water, is to be effected simply by reversing the position of the wheels and substituting air as the motive power for compression downwards to the chamber at the bottom of the wheel, so that by its buoyancy it may, in its tendency to ascend to the surface of the water, pull round the wheel.

1858.—Marc Antoine François Mennons [No. 566], of Paris, and Finsbury, London. "Certain improvements in the production of motive power." This invention consists in constructing machinery for utilising gravity and centrifugal force for obtaining motive power. The machinery is composed—first, of a peculiar pendulum or swinging lever, which, after receiving an oscillating motion by the hand acting on a cord, comes in contact with springs which cause the pendulum to rebound and continue oscillating. This motion is further assisted by means of the gravity of water, or other liquid, placed in tubes or receivers at the bottom of the pendulum, &c. This invention had only six months' protection.

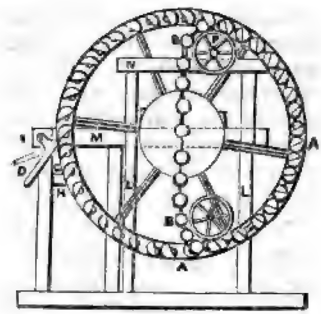
1858.—George Hale [No. 1374]. Levers on a shaft—as before. (See 1854, No. 2589.)

1858.—George Singleton Hill [No. 1743], of Ryde, Isle of Wight, Miller. "Improvements in hydro-pneumatic machinery." The invention, completely patented by this patentee, "is based on the principle that atmospheric air will sustain a column of water varying from twenty-eight to thirty-two feet in height, according to its pressure indicated by the barometer." He says his machinery "consists of a water-wheel of about twenty-eight feet in diameter, a cistern or well underneath it, and a tank about three or four feet deep fixed above the wheel; there are to be fitted to it as

many pumps as required for pumping the water into the tank above, to be driven by the water-wheel." A large drawing is given, in describing which the patentee complacently informs us—"The suction pipes I descend into the cistern K, formed beneath the wheel, where the water employed in turning the wheel collects, and is elevated by the pumps G to the top of the wheel again." This is remarkable under any circumstances, but more so as thus recorded in the Patent Office by a practical man, and a miller too.

1858.—PIERRE RICHARD [No. 1870], of Rue St. Jean, Paris, Engineer. "Improvements in apparatus for obtaining motive power."

The invention consists in communicating a rotary motion to a fly-wheel or drum by means of a set of falling weights tied together by means of chains, ropes, or straps. This set of weights, forming an endless chain, runs over two pulleys, or rollers, suitably disposed up and down near the fly wheel, which is provided with a set of cups suitably shaped, and fixed around near its periphery, so as to receive the weights as they are delivered up by the upper pulley, and to carry them down to the lower pulley, whence the same weights re-ascend in a straight direction to the upper pulley. The weights of the endless chain running or falling down in the curvilinear direction of the periphery of the drum are more numerous than those that are raised up in a straight line, because the curvilinear line is longer than the straight one, and the difference of heaviness due to the number of weights is the force which, by its action at the end of the levers or radii of the drum, causes that drum to rotate.

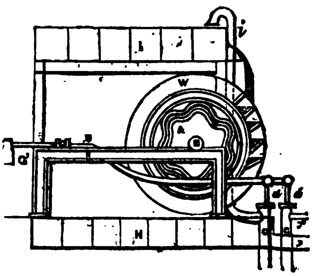


The drawing shows an endless chain composed of twenty-five rounded weights or balls, fifteen of which are carried by

the cups or bowls mentioned, whilst the ten other weights are ascending freely in a straight line, being carried upwards by the excess of weight of the former. L L L, feet of the frame bearing the whole apparatus; A A, fly wheel or drum; P P, pulleys or rollers, over which runs the endless chain, composed of rounded weights B B B, which are tied together by strings or straps as aforesaid. The shafts of the pulleys P P run on bearings fixed upon the cross pieces N N of the frame; the shaft of the drum runs upon bearings fixed upon the cross piece M of the said frame; C C C, cups or bowls fixed around the drum A A. The machine being set in motion, will keep on running to perform any work which may be applied to it. It can be stopped by means of a brake G, acted upon by a lever D worked by hand. When the lever is brought at D, the brake is tight, and the drum A stops.

1858.—JAMES BLACK [No. 1933], of Edinburgh, Machine Maker. "An improved mode or means of obtaining, applying, and transmitting motive power."

A face plate or disc is fixed on an axis, and has formed in it a number of wipers, eccentrics, or curved paths, which receive (in the space taken out) a pulley or roller, free to revolve on its own axis, and attached to an adjustable lever in equal balance with the desired lift or pressure. On rotary motion being communicated to the plate (by a band or otherwise), the pulley or roller moves round the eccentrics or paths, imparting a rocking motion to the lever (similar to the action of a beam), wherefrom motion may be transmitted or applied, as desired, or converted by suitable appliances into any description of motion.



In connection herewith, a pump may be set in a tank of water, and a tank added above; on the same shaft with the face plate is a water-wheel driven by the water from above; when it

passes the centre, the water falls into the lower tank and is pumped up again; whatever weight of water is in each stroke is equalized by a balance weight on the lever; the number of eccentrics and size of water-wheel may be increased to correspond with the quantity of water required to secure a desired power.

One means of imparting rotary motion from my arrangement is by attaching at the end of the lever a crank and connecting rod of same radius as the lift of the lever, carried over the centre by a fly wheel.

The invention is applicable to the actuating of pumps, mincing machines, and other machinery, instruments, and apparatus, and to parts thereof; to propelling on land and water, and to various motive purposes.

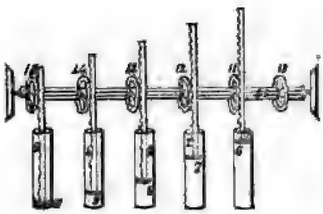
Fig. 1 is an elevation, showing an arrangement for obtaining power according to my invention. X is the general framework of the apparatus; A, a disc or plate, mounted on a shaft E, and formed with curved paths B; the same shaft E also carries a water-wheel W, provided with vanes or blades *w w*, as is usual; C is a roller, working in the paths B, and connected to a lever D, attached to rods *d d* of pumps G G. G^1 is a balance weight at the further end of the lever, which is supported in the bearing *f*; H H are tanks fixed below the water-wheel, and I is a tank set above it; *i i* are supply pipes, for conveying the water from tanks H H to the tank I; *j j*, escape water pipes. The water falling from the tank I on to the wheel W, drives that wheel in the usual manner; and when it passes the centre, the water falls into the lower tanks H, from which it is pumped up again into the upper tank I by the pumps G, actuated by the levers E, driven by the rollers C, in the pathways B of the face plate A, as the latter is caused to revolve by the revolution of the water-wheel W on the same shaft with it, thus producing a continuous motive power.

1858.—JOHN COATES [No. 1934], of Lower Shadwell, London, Engineer. "Improvements in apparatus or machinery for obtaining and applying motive power."

A complicated machine is described, of which he says:—"The cylinder, the tubular portions, and the trough are filled with water, and the working of the piston causes the alter-

nate admission and expulsion of the water, thereby putting the engine into motion." He adds: —"The water that supplies the engine cylinder ascends the (hollow) column supporting the beam." The patent has no drawing; but though completed, the construction of the engine and its precise intended mode of working are not very obvious.

1858.—Peter Pickering [No. 2142], of Danzig, Prussia, Landed Proprietor. "An atmospheric engine." 1, 2, 3, 4, 5, cylinders 18 feet long or high and 3 feet diameter, so that the surface of each piston has 1,296 square inches acting with an atmospheric pressure of 15 lbs. to the square inch, causes a pressure of 19,440 lbs. to each cylinder (saying nothing of friction, which will be accounted for later); 6, 7, 8, 9, 10, pistons of each cylinder, as they must be placed when the engine begins to work; 6, 7, 8, 9, causing a vacuum under each piston (as they have for the first time been brought into their present situation by main force), afterwards, when the engine is permitted to start, they will regulate themselves; No. 10 lies flat on the bottom of the cylinder; 11, 12, 13, 14, 15, piston rods acting on shaft No. 16; 17, wheel to communicate the engine's power to the machinery of the engine itself; 18, wheel to communicate the engine's power to the wheel or propelling screw of a ship, manufactory, locomotive, &c.



1858.—Robert Wright [No. 2530], of Manchester, Jeweller; and T. J. Mercer, of Coventry, Watch Manufacturer. "A new or improved motive power engine." "Our invention consists of an engine by which motive power is obtained by the use of compressed air, which said engine also effects the compression of the air, by the expansive

power of which the motive power is obtained." This looks very like an intended perpetual motion, but in this provisional specification is insufficiently described.

1858.—MOSES STARBUCK No. [2708], of New York, America. "A static pressure engine." In his very brief provisional specification, all published, he says:—"My invention consists in the application of a static pressure to produce a continuous movement, which movement is effected in consonance with the settled laws of mechanical philosophy, by means of arrangements of devices heretofore undeveloped. By means of these devices, I am enabled to convert a static pressure into a continuous movement, from which the static pressure (minus the friction of the engine) can be continually given off for the purpose of moving any machinery to which the engine may be applied.

1858.—JOSEPH MARIE ROUSSEL [No. 2853], of Paris, Mechanician. "A new system and new apparatus, using air as a motive power." A drawing accompanies the provisional specification; but the patent, not being completed, has, like many more, lapsed in consequence. Compressed air is used, and the patentee assures us that—"The motor once set in motion, the pumps supply air in a quantity sufficient to compensate in the great reservoir that already used."

1859.—HUGH RIGBY [No. 754], of Salford, Manchester, Engineer. "Improvements in machinery or apparatus for obtaining motive power, applicable to hoists, and all other purposes to which motive power can be applied."

He says:—"I employ an upper reservoir of water of any suitable capacity, and, by means of a regulating valve, allow the water to fall upon the buckets of a water-wheel or turbine, the water being delivered into a similar reservoir below. The water-wheel or turbine gives motion to a series of hydraulic pumps, for the purpose of forcing the water into one or more hydraulic rams, to each of which a larger pump-bucket is attached, working in a suitable barrel, the bottom

of which is placed in the lower reservoir. As the water-wheel or turbine turns from the supply of water, and gives motion to the series of pumps, the ram or rams rise, and raise the larger bucket or buckets, the effect of which is to raise the surplus water from the lower reservoir to the upper, which latter is thus continually supplied; which, acting on the wheel, obtains a motive power in proportion to the dimensions of the parts." Need more be said? We have quoted the patentee's own statement from a complete specification of three printed folio pages, accompanied by four large sheets of illustrative drawings! Yet Manchester is distinguished for its engineers and machinists.

1859.—JAMES RANDAL SMITH [No. 1057], of Glasgow. Gentleman. "Improvements in obtaining motive power."

Under one modification, the apparatus or machinery consists of a wheel with a tubular or hollow rim capable of revolving in a vertical plane upon a horizontal axis or centre of motion. To the periphery of this wheel there are attached at equal distances asunder and all round it a series of open cages or chambers, each containing a flexible diaphragm of a tubular or bag form. The two ends of each chamber or flexible bag-holder are solid discs, to one of which one end of the flexible bag is attached so as to be fluid-tight, and a water thoroughfare or tube passes from this end disc to the wheel rim, so that there is a free passage from the hollow rim into the interior of each flexible bag. The opposite end disc has attached to it a spring of any convenient kind, and between this spring and the end of the flexible bag on that side there is interposed a heavy disc weight. This weight fits loosely to the interior of the bag chamber, and it is attached to the free end of the flexible bag so as to be fluid-tight. The tubular or chamber space in the main wheel is filled with water, mercury, oil, or other liquid, and its operation is this:—Supposing there are eight flexible bag chambers, and that the position of the wheel is such that there are two diametrically opposed chambers in an accurate vertical line or plane, whilst of course there are other two in an accurate horizontal line, the remaining four chambers holding relatively of course positions in lines of 45 degrees with the horizon, and supposing the wheel to be intended to revolve to

the right or in the same direction as the hands of timekeepers, then one of the flexible bags in the two chambers in the horizontal plane, the one to the left, or the ascending one, is empty of water, the disc weight being on the top of it so as entirely to collapse it, the opposite bag of this pair, or that on the descending side, is full of water, the disc weight having distended it by falling down upon the spring on the end of the chamber, so that water or other liquid matter in the wheel has flowed from the wheel into the interior of the bag. The next bag beneath the full one on the descending side, or following the direction of the revolution of the wheel, is also full of liquid, but its weight is of course acting upon the wheel with a reduced leverage as compared with the one above it. The bottom bag is also full of liquid, but of course inert as regards its operation upon the revolving action of the wheel. The next bag on the ascending side is half full of liquid, the weight and spring being above it. The next to this, as already described, is empty, as also is the following one, and the top one of all, whilst the first or uppermost one on the descending side is half full. This description shows that there is a preponderating weight upon the descending side of the wheel, causing the latter to revolve, and this preponderance is kept up throughout the whole revolution, as each bag comes into and goes out of action.

According to another arrangement, motive power is obtained by a peculiar system of toothed wheel gearing. The principle involved in this arrangement may be carried out in working practice in many ways. According to one arrangement, this combination involves twelve wheels; of these, eight are bevil wheels, disposed in four pairs, the individual wheels of each pair being set at an angle or inclination one with the other, each wheel being set loose upon the end of an inclined or angularly-disposed lateral stud, the whole being carried upon a pair of parallel horizontal shafts, so as to form a parallelogram in plan. When the set of weights on one side have descended to their lowest positions in virtue of the half revolution of two of the pairs of bevil wheels, their action upon the interposed wheel on that side has also caused the other half of the train of four bevil wheels to turn round or swing over upon the main centre, as before referred to, and thus their weights are brought at once to their highest positions, and just past the centre, for the purpose of again giving motion to the arrangement for the

succeeding half revolution, and in this way the revolution is kept up continuously as each set of two pairs of bevil wheels turns alternately upon the main centre. The essence of this portion of the invention being the obtainment of continuous revolution from weights disposed upon inclined wheels or discs, in combination with the reversing action of these wheels for again bringing the operating weights to their highest positions of work.

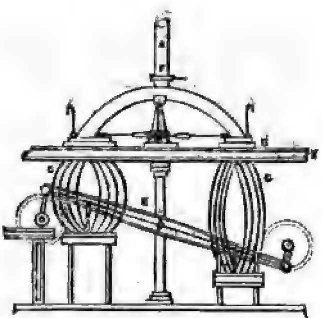
1859.—MOSES HAYM PICCIOTTO [No. 1413], of Finsbury Circus, London, Merchant. "Improvements in apparatus for producing or obtaining motive power."

My invention consists in combining apparatus in which motive power is produced by the gravity or pressure of a permanent column of fluid in a stationary pipe, the base of which is connected to a fixed cistern or chamber, to the bottom whereof are attached a number of vertical flexible tubes terminating in and attached to a moveable plate, piston, or vessel, capable of travelling up and down (in guides or in a cylinder), the flexible tubes bending and unbending as the moveable plate, piston, or vessel rises and descends. This plate, piston, or moveable vessel is also connected to one end of a beam, the other end of which is connected to a precisely similar apparatus, also consisting of a like set of flexible tubes, attached in like manner to a fixed chamber (communicating with the column of fluid), and to a moveable plate, piston, or vessel, communication being opened between the main pipe and the flexible tubes at one end of the beam; the gravity or pressure of the column of fluid will act upon and force down the plate, piston, or moveable vessel at that end, unbending the tubes, and bringing down the corresponding extremity of the beam, whilst at the same time communication is closed between the main pipe and the flexible tubes at the other end of the beam, causing such end to rise, its tubes bending accordingly, to facilitate which operation a small quantity of the fluid contained therein may be let off to be pumped back into the main pipe. The action is then reversed, communication being opened on the up side, and closed on the down side, and so on, whereby reciprocating motion is produced and motive power obtained. The power may be increased by adapting

similar means to the under side of each of the plates, pistons, or moveable vessels, in such a manner as to cause the gravity or pressure of a column of fluid to act upward on the plate, piston, or moveable vessel when the downward pressure of the fluid contained in the first-mentioned main pipe is removed, by closing the communication thereof with the upper set of tubes, the pressure acting upward on the plate, piston, or vessel at one end of the beam, while acting downward on the plate, piston, or vessel at the opposite end, and *vice versa.* The flexible tubes may be so contrived as to bend into an arc, spiral, or other convenient form. The apparatus may be adapted to act horizontally instead of vertically. The term fluid, when employed in this specification is intended to comprise water and other liquids, gaseous and aeriform fluids, and mercury and other substances in a fluid state.

I now proceed more particularly to explain my said invention.

Figure 1 is an elevation of an apparatus constructed according to these improvements. A is a pipe, which I call the main pipe, and which contains the column of water or other fluid, from the pressure or gravity whereof motive power is to be obtained. This pipe A is fixed to brickwork or in a general framework X, and terminates at the lower end in two branches A^1 A^2, whereof A^1 leads into a chamber B^1, also fixed to the framework X, and perforated on its under surface for the reception of a number of flexible tubes C^1 C^1 C^1, attached to it at their upper ends, and connected at their lower ends to a vessel D^1, as shown in the plan, Figure 2; such vessel travelling up and down in stationary guides a^1 d^1. e^2 is an arm or link by which the vessel D^1 is attached to a beam E. The branch pipe A^2 in like manner leads into a chamber B^2, with flexible tubes C^2 C^2 C^2, terminating in a vessel D^2, working in guides d^2 d^2, and connected by an arm or link e^2 to the beam E;



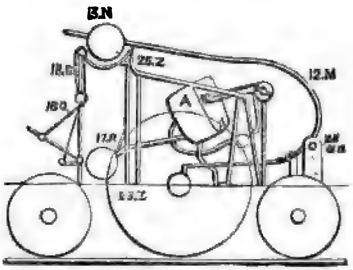
the arrangements of the parts B^2 C^2 D^2 d^2 e^2 are precisely similar to those of B^1 C^1 D^1 d^1 and e^1 respectively. The tubes of the set C^1 are equal in number to those of the set C^2, and the collective area or surface of the bores of the tubes in either set is nearly equal to the surface of the bore of the main pipe A. Thus, for example, suppose the diameter of the main pipe A were 12 inches, giving 108 square inches of surface, then the same amount of surface would be presented in either set of tubes collectively. f^1 f^2 are valves working to and fro in valve boxes g^1 g^2, and actuated from the fly wheel shafts, or other part of the machinery, in the manner hereinafter described for opening and closing communication between the main pipe A and the flexible tubes on each side of the beam; they are so arranged and operated that when the end h^1 reaches the bottom of its stroke, the valve f^1 closes, and cuts off communication between the fluid in A and that in the tubes C^1, and when that end h^1 has reached the top of its stroke, the valve f^1 opens and permits communication between the fluid in A and that in the tubes C^1; in a similar manner the valve f^2 closes when the end h^2 has reached the bottom of its stroke, and opens when it has arrived at the top of its stroke. The valves are so regulated that one valve must always be quite closed before the other valve begins to open. Instead of two valves f^1, f^2, a single pivot valve or a ball or circular valve may be used, being fitted at the bottom of the pipe A, and so actuated as to open and close communication on each side alternately, or a two-leaved or other convenient valve or valves may be employed for the purpose. F is a cut-off valve near the bottom of the pipe A, opened by means of a lever handle to start the engine, and left open while it is at work.

1859.—Prince Gustave Gennerich [No. 2815], of Poland. "A new system of motive power applicable for working cranes and wheels."

The present invention is a motive power applied to a crane for raising goods instead of multiplied hands or steam power. The principle consists of a heavy weight sliding on an iron rod which is attached to the axis of a wheel, and by means of a snap fastened to the rod causes the wheel to

revolve. By means of the heavy sliding weight the cylinder to which the chain is attached is made to act with great power. The same power may be applied in any case where a wheel or crank is required to be turned, as by the heavy weight sliding to and fro the iron rod acts as balance and creates a power, and by moving up and down turns a wheel or crank.

Figure 1, A, a heavy weight containing four wheels inside as is indicated 2, A, running on two rods, 3, B, C, the weight 4, D, the chain, 5, E, and connected with a communication rod; 6, F, another chain, 7, G, and 8, H, which are attached 9, I, and 10, K, which is just the position which drew down the driving lever for the wheel; 11, L, the other chain; 8,



H, is dropping into a wheel, 12, M, driving weight, 13, N, standing upright, being the time of change to draw up the sliding or the gennero-motive power weight for another revolution of the wheel 12, M, is inclosed in a little catch, 14, O; 15, P, a lever; also, 16, Q, is the start for the motion of the gennero-motive or the new system of motive power. The lever 15, P, drawn down, draws up by means of a chain 18, S, a weight 17, R, which has lost all its power and gives to Figure 13, N, the full power to draw down the lever 12, M, for another start for the gennero-motive weight, and so it goes constantly with the two levers 15, P, and 16, Q, the two weights, 13, N, and 17 R, being placed opposite each other and attached with a chain sliding on wheels between them 19, T, while drawing down the lever 12, M, Figure 17, R, is eased by the lever 15, P, and drawn up with the lever

and weight 13, N; 20, U, and 21, V, are levers for the driving lever of the eccentric wheel; 22, W, adopted for the perfect revolution of the driving wheel without fly-wheel or balance; 23, X, is a lever which is pressed down only by the weight 13, N, and doubles the power, acting together with the gennero-motive weight, only for the revolution of the 12, M, the lever; 10, K, exercises the same power, only in a different manner; 1, A, has only a bar of iron catching in the frame; 3, B, with Figure 24, Y, the frame of the entire engine is starting off; 3, B, C, in which the axle runs; 25, Z, Figure 26, A, A, is a very strong frame, in which a very great power is exercised, in which the axle of 10, K, and 12, M, runs through; 27, B, B, a frame in which the lever for the driving wheel is attached. For the conclusion 28, C, C, everywhere where a hole is running through to be fastened with screws and nuts.

This is the entire description of the gennero-motive or the new system of motive power exercised by means of weights, levers, and chains, to be used to any extent of power; even the engine does not require to be larger, only the weights must be increased.

[The engraving of this complicated machine in its reduced size is curtailed, and many references obliged to be omitted; its impossible nature, however, is evident.]

1860.—George Redrup [No. 272], of Loughborough, Leicester, Brewer. "Improvements in the means of and apparatus for obtaining and applying motive power whereby perpetual motion may be obtained." Here is no concealment of the real object, as in most titles. The entire provisional specification is as follows:—

My invention consists of cylinders with pistons working up and down, or to and fro as may be required, which are actuated by simple or compound levers. I use a small cylinder similar to that employed in ordinary steam engines. Instead of using steam power, I attach to each end of the cylinder which I here call the smaller cylinder, an elbow of cast iron or other metal with the top part large enough to screw or fix on a large cylinder in which I have a piston working as may be required. On the top of each of the

large cylinders and on the side nearest the small cylinder, I fix a piece of iron or other metal, or if preferred I cast the same with the cylinder for the purpose of fixing in the end of a lever near to this which I call the fulcrum, and upon the lever I attach the piston of the large cylinder in a similar manner to that which is applied to force and other pumps. At the end or long end of the levers, I propose to to attach either in a fixed or moveable position a weight which will impart considerable pressure to the piston of the large cylinders. Inside the small cylinder is a piston, with the piston rod working through a stuffing box, which stuffing box is fixed on the elbow at one end of the cylinder, the said piston rod being connected with machinery as in steam engines for turning a crank, the piston working to and fro communicating a rotative motion. Underneath, or in any required position relatively to each of the levers which act on the piston of the large cylinders, I employ simple or compound levers with the short end placed close to the end or weight of the lever attached to the cylinder, so that a small weight applied at the long end of the under lever will raise both the weight and lever which are attached to the cylinder, and which when raised takes off the pressure from the piston. These levers are acted upon by certain parts of the machinery when in motion, either by weights, springs, a wheel or wheels, or other apparatus having cord or other suitable material attached; I have also various other modes of acting upon them alternately, and they are moved when the piston arrives at or near either end of the small cylinder, or when required. Inside the cylinders, that is to say, on each side of the small piston and between that and the pistons of the large cylinders, I place a requisite quantity of water or other fluid to be acted upon on each side alternately by the pressure of the lever, piston, and weight of the larger cylinder as before mentioned.

In farther explaining my invention, I suppose a machine to be charged with a proper quantity of water, oil, or other fluid, the piston of the small cylinder being nearest the stuffing box, and the weight or pressure being removed from the large cylinder farthest from the stuffing box, by means of a lever or levers acting upon the upper lever, thereby lifting up the end of the long lever the height required, the pressure then being applied on the water by means of the

lever, piston, and weight, as before mentioned, on the large cylinder near the stuffing box; now suppose the large cylinder to be six times larger than the small one, while the piston descends one inch, the smaller piston would be forced six inches, causing the water to rise higher in the cylinder with the pressure relieved. When the piston and small cylinder have moved their proper distance from the stuffing box, the machinery will instantly take off the pressure by the levers from the end just forced down, that is to say, the piston of the cylinder nearest the stuffing box, and will put the whole pressure on the water in the other cylinder, which would force the small piston back again towards the stuffing box; the machinery before mentioned acting upon the levers reverses the pressure as before, so that a continual or perpetual motion is kept up. One particular arrangement of my engine is constructed with a small cylinder placed horizontally, and with a large cylinder placed perpendicularly, but I do not confine myself to the foregoing mode of working, fixing, or arrangement, as the same may be varied or modified as circumstances may require.

1860.—THOMAS EDWARDS [No. 930], of Great Tindal Street Works, Birmingham, Engineer. "Improvements in obtaining motive power."

This invention relates to a peculiar system or mode of obtaining motive power, and consists in the employment for that purpose of a continuous pressure obtained from steam, air, gases, or fluids of any kind, such pressure acting upon a revolving piston inside a cylinder. This piston is provided with two metallic packing strips forming a line of contact with the opposite sides of the interior of the cylinder, one of such lines of contact being formed on the abutment side of the piston, and the other on the pressure or power-exerting side of the piston. The axis or shaft of the rotatory piston is placed eccentrically within the cylinder, and the cylinder accommodates itself to the changing positions of the piston in its revolving or circular motion. The medium or agent employed for obtaining the requisite pressure is admitted by a suitable divided passage cast in the shaft, each compartment communicating by an opening or passage with either side of the revolving piston, so that the engine may be

reversed at pleasure, by simply directing the agent used through one or the other of the passages by any convenient valvular arrangement.

The essential feature of novelty in this engine is the total absence of all exhaust when in motion, the motive power being produced by the constant pressure of the medium or agent inside one half of the cylinder exerted against the revolving piston; any suitable packing may be used on the ends of the piston next the cylinder covers.

This patent did not proceed beyond provisional protection; and, though not expressly so stated, yet must be for a perpetual motion, if the inventor has discovered a mode of obtaining "continuous pressure" through pneumatic or hydraulic agency acting on "a revolving piston inside a cylinder," under "the total absence of all exhaust when in motion."

In the foregoing statements of English patents, we have (including those in Chapter III.)—that is, to June, 1860—seventy-four patentees, who obtained eighty-four patents. It is curious to observe their several stations in life. We find a Prince, a Baronet, two Counts, a Knight of the Tower and Sword, a General, a Groom of the Privy Chamber, the Governor of Trinity Ground, a Doctor of Divinity, two Doctors of Medicine, two Surgeons, a Bachelor of Arts, ten Gentlemen, four Merchants, ten Engineers, three Civil Engineers, an Architect, a Surveyor, a Contractor, a Manufacturer, a Brewer, a Millwright, a Miller, five Machinists, a Carpenter, a Draftsman, a Jeweller, a Watchmaker, a Confectioner, a Shoemaker, a Custom-house Officer, with nine persons and seven foreigners undescribed. The major portion of these must have been persons above mediocrity in position and education, so that the pursuit of Perpetual Motion has been far from being limited to an unintelligent class, as boldly assumed by many insufficiently-informed writers. Their patents cannot have cost much, if any, less than £4,000—a large amount to pay for the empty privilege of possessing letters patent to so much moonshine!

French Patents.

The following particulars of Patents for Perpetual Motion are translated from "Description des Machines et Procédés pour les-quels des Brevets d'Invention ont été pris. Paris." Quarto. They are arranged under the head of "Moteurs," and, though extracted entire, afford but little information:—

1. M. J. B. Fauche; for a machine called "Motasipse," intended to realise perpetual motion.—August, 1845. (Vol. 1, p. 127, 1850.)

2. M. Guenee. The inventor tries to utilise the movement of a case of mercury placed on a moveable tressel, by which the centre of gravity is displaced.—December, 1844. (Vol. 1, p. 289.)

3. M. Peydiere. He has constructed a system of rails forming three railways, and says that after the first impulse given to a waggon of his construction for this railway, its movement would be perpetual, or at least greatly augmented. —December, 1844. (Vol. 1, p. 305.)

4. M. Durand. He raises water from a well, which water he proposes using to operate the pump employed. (Vol. 4, p. 193.)

5. M. Grellet; for a perpetual movement.—August, 1845. (Vol. 5, p. 97.)

6. M. Lemoigne. The inventor raises water by means of a pump, and causes the same water to work the pump. (Vol. 5, p. 187.)

7. M. Chalette-Thevard; for mechanism having a perpetual movement, described in his patent and certificate. —October 22, 1846. (Vol. 5, p. 190.)

8. M. Moinau. In his patent and certificate, dated September, 1846, the inventor describes a machine in which a pump raises a certain quantity of water, and is kept in movement by the same. (Vol. 6, p. 6.)

9. M. Georges. The inventor claims a mode of turning a windmill by means of bellows; and considers that the mill ought to cause the bellows to work.—April, 1846. (Vol. 6, p. 208.)

10. M. Fouillet has a perpetual movement. (Vol. 8, p. 23.)

11. M. LEGENTIL. He has a combination by which he forms a break wheel, which after a first impulse is intended to move the machine he has invented, leaving a disposable extra power. (Vol. 9, p. 149.)

12. M. ROLLET. The inventor desires to make and maintain a power by his arrangement of certain levers and weights.—May, 1847. (Vol. 10, p. 265.)

13. M. PEYDIERE; for a perpetual movement.—January, 1851. (Vol. 18, p. 348.)

AMERICAN PATENTS

For Perpetual Motion are generally considered to be rather numerous, but no adequate opinion can be formed by consulting mere Patent Lists, which give only the Titles. However, as Patent Specifications and Models previous to 1837 were destroyed in the fire which occurred at Washington, the following List of Patents, previous to that period, may be offered as referring, most likely, to intended self-motive machines:—

PETER OVERT, New York. Power and motion by weights. —Dec. 18, 1813.

JAMES WIDDIFIELD, Philadelphia. Perpetual waterwheel.—April 21, 1817.

CHARLES REDHEFFER, Philadelphia. Gaining power.—July 11, 1820.

CAM BROYLES, Tellico. Power for propelling machinery by weights.—Oct. 19, 1827.

JOEL ESTES, Brownsville Power for propelling mills by rolling and balance wheel.—August 15, 1831.

WILLIAM RHODES, Trenton. Power for propelling mills by lever.—April 27, 1832.

L. H. EMMONS and G. UPHAM, Masillon. Power for propelling mills by balance lever.—May 16, 1833.

OBED R. MARSTON, Java, U. S. Power by weights.—Jan. 9, 1835.

LUKE M. EDWARDS, Trenton. Power for propelling machinery, called lever and dead weights.—March 2, 1835.

ELISHA TURNER, North Pownel. Power by weights.—June 12, 1835.

J. J. GIRAUD, Baltimore. Self-motive power.—March 31, 1836.

On this peculiar class of patents, here concluded, we have but little further to remark.

Whether the matter thus brought under notice amounts to any proof of scientific progress or not; whether it claims our congratulation or not, who can doubt? Much assuredly has been attempted, much done, yet what remains is, after all, but a baseless fabric. The grand problem itself remains as great a mystery as when it was first propounded. It has, therefore, been customary to associate the pursuit with Alchemy, Judicial Astrology, and similar chimeras. But as a mechanical effort, it compares and ranks rather with such schemes as the many ingenious attempts at Flying, Submarine Navigation, and Electro-motive Engines, all of which have, in turn, led to elaborate, expensive, and futile experiments. If common sense be appealed to in the matter, it readily suggests itself to us to exclaim with Cowper:—

"Defend me, therefore, common sense, I say,
From all idle enterprises, light or vain;
From dropping buckets into empty wells,
And growing old in drawing nothing up."

But scientific inquiries are governed by no such standard; their results are generally in advance of the age, and in every sense uncommon. Something might be hoped from Mathematics; but Mathematical Science is the follower or servant of arts, and not their precursor or master; much as it owes to the results of invention in affording it matter for its valuable demonstrations, no invention whatever owes its

origin to mathematical science—in short, it can only operate on fixed or assumed data; and it is evident that that which is assumed correct in Figures may fail on the test of Facts. On the question, Whether Perpetual Motion is possible or impossible, therefore, on all the evidence we have been able to adduce, the only verdict we can conscientiously give is that of *Non proven*.

CHAPTER XII.

SUMMARY REMARKS.

In bringing this collection of curious and hitherto scattered information to a close, a few remarks are necessary that could not have been better offered than in the present summary.

The writer, like most collectors desirous of completing a series, has been disappointed in obtaining reference to some few works, particularly—

1. A Dialogue concerning Perpetual Motion; by Thomas Timme, or Tymme, Minister. London, 1612, 4to.

2. De Inventione Æterni Motoris; by James Zabarella, Teacher of Logic at Padua, where he died 1589. Francfort, 1618, 4to.

3. Essay for a Machine of Perpetual Motion; by Robert Stewart. Edinburgh, 1709, 4to.* And—

4. An Account of the Automaton or Perpetual Motion of Orffyreus; with additional remarks; by William Kenrick, LL.D. London, 1770.†

Many works which appeared likely to afford information proved very deficient on reference to them. Dingler's Polytechnic Journal, Stuttgart, as one among many other voluminous periodicals, was found to be supplied from very ordinary sources on the subject under investigation.

Of the great mathematicians and philosophers who have noticed the matter, the following particulars will interest the general reader. Dr. Denys Papin, an ingenious physician,

* See "A Perpetual Motion Advertised," Chap. IX., page 371.

† In Montucla's works reference is made to a Lecture on Perpetual Motion, by Henrich; London, 1770. Most likely he meant "Kenrick." (See Chap. V., p. 147.)

born at Blois, was elected a Fellow of the Royal Society, 1680. GODFREY WM. DE LEIBNITZ, an eminent mathematician, was born at Leipsic, 1646, and died 1716. PHILIP DE LA HIRE, a celebrated mathematician and astronomer, was born 1640, and died 1718, at the advanced age of seventy-eight years. WM. JAMES 's GRAVESANDE, a distinguished Dutch philosopher, was born 1688, and died 1742. JOHN T. DESAGULIERS, a great experimental philosopher, was born at Rochelle in 1683; he was elected a Fellow of the Royal Society 1714, and died 1744. And JOHN BERNOULLI, a celebrated mathematician was born at Basil in 1667, and died full of honours in 1748, in the eighty-first year of his age.*

Dr. Kenrick's strangely-composed Lecture on Perpetual Motion appears in an abridged form at page 54. The copy from which it was taken was either imperfect, or the entire lecture was never published. He declares himself to be the inventor of a machine for perpetual motion, and which, judging from a letter in the "Gentleman's Magazine" (p. 48), would appear to have been pretty well known, and called a "Rotator." On the same authority it also appears that a subscription was commenced to remunerate the inventor. The lecture was printed 1771, the above letter written 1772, and Dr. Kenrick died 1779, the very year when (as we find at page 178) he applied for a patent simultaneously with J. D. Muller. The latter was obtained the same year, but no steps whatever seem to have been taken by Dr. Kenrick beyond his appearing before the Attorney-General. This may be attributed either to his having only applied in the way of opposing Muller's claim, or to extreme illness, resulting in his early decease.

We have not met with the slightest allusion to the Marquis of Worcester's invention in any French or German writer. So many editions of the "Century of Inventions" have been published from 1663, 1746, 1767, down to 1825, that the

* For his demonstration in favour of the possibility of perpetual motion, see Appendix H.

circumstance is not a little remarkable. We feel satisfied it cannot have arisen from any jealousy in according to him priority of invention, the invention being still in abeyance. And certainly French Biographies give no very charitable or agreeable account of the life of Orffyreus; while German writers of his period soundly abused him as an empiric and charlatan; and his alleged invention was pronounced unworthy of credit. Such writers, from their silence, must have been entirely unacquainted with the "Century of Inventions;" but we do not feel so well assured that it was equally unknown to Orffyreus, a man of reading, various experience, and meeting men of all grades through the fame of his reputed discovery.

With regard to the Marquis of Worcester, we may here mention a singular misnomer in naming him as Henry Somerset, instead of Edward Somerset, the former being his father, himself an author. In the excellent and generally accurate Bibliothecas by Watt and by Lowndes, this glaring mistake occurs, and they serve to propagate the error.

The proper name of Orffyreus was Bessler; but for some whim, not explained, he adopted a stenographic or cypher designation, produced by writing the letters of the alphabet in two lines, and selecting the letter above or below (as might happen) each letter of his family name. A further short notice of his invention will be found in the Leipsic Acts, 1715.*

The number of patents that are recorded will, no doubt, create general surprise; and yet some may have escaped notice owing to adopting titles as little explanatory as possible of the patentees' real object. This circumstance occasions the patents under this particular head, in the Patent Office indexes, to appear as not exceeding a dozen!—the remainder appearing as "Motive Powers," and taking rank with steam engines, &c. In such cases, the only course is to

* See Appendix G.

refer to the specifications, and where this could not be done, as in foreign patents, the lists are necessarily defective. If invention in this department showed any vigour, any signs of progressive improvement, this fact would prove a serious drawback. All circumstances, however, considered, it may really be acknowledged, by many, as a great relief from absolute surfeit.

The effect of the entire collection of evidence now offered on both sides the question must naturally be to induce a belief in the impossibility of Perpetual Motion; and that, as it cannot be relied on as attainable on any scientific grounds, scientific men must discredit its possibility; or, if they waver at all, it must be solely on a moral consideration that it is just within the bounds of possibility there may be something worthy of belief in the word and evidence adduced in favour of the inventors and their inventions, as regards the Marquis of Worcester and Orffyreus. By making known all opinions and all plans that could be obtained, further delusion will assuredly be stayed, and instead of an oscillatory movement, the inventor, in future, will be necessitated to show at least some progress towards a genuine motive power. If, in one sense, the collection appears to some as offering a bane rather than what is desirable, it must not be overlooked, on the other hand, that the antidote is tendered along with the magic chalice. We are no friends to mystery, and cannot understand why this, any more than any other subject of scientific inquiry, should not be brought to light, anatomized, and the scalpel applied to the tracing of its most secret operations. It is time the early dreams of philosophy were dispelled; and this is not to be effected by substituting any modern romance of engineering. Let no one henceforth be overcome with the "delicious delirium" that, by any occult process, he can effect motive power by models outraging the "natural magic" of natural philosophy.

APPENDIX A.

Theatrum Machinarum Generale. By Jacob Leupold. Leipzig, 1724. Folio.

§ 58. Wie zwen bekandte Machinen wodurch viele das Perpetuum Mobile erhaschen wollen, aus dem Abstandt der Gewichte zu berechnen ?

Das Perpetuum Mobile, oder eine machine, die ohne ausserliche Krafft unaufhörlich, so lange die Materialien dauren, und nichts zerbricht, sich selbst beweget, ist dem Nahmen, nach heut zu Tage so bekandt, dass auch die geringsten handwereker, ja Schuster und Schneider, nicht nur davon zu reden wissen, sondern auch sich einbilden, das sie dargleichen machen wolten, wenn sie nur unkosten und zeit hätten ; denn ist eine sache in der welt, wornach viele mit grossen Verlangen, Zeit, Fleiss und Unkosten gestrebet, so ist es gewiss das Per. Mo. D. Becher hat 8 Stück angefuhret, wonach man jederzeit eifrig getrachtet, als da sind : 1, Der Lapis Philosophorum ; 2, Liquar Alcahest ; 3, Das glassveich zu machen ; 4, Ein ewiges Licht ; 5, Eine Linie Hyperbole in einen Brenn-Spiegel ; 6, Die Longitudo zur See ; 7, Die Quadratura Circuli. Und endlich ; 8, das Per. Mo. ; Alleine weder goldmachen, so doch das herrlichste Ding in der welt ist, und alles vermog, noch anders, ist von so vielen als das Per. Mo. gesucht worden ; ursach : weil bey jenem mehr kunnst und wissenschafft in der chymie erfordert wird, hier aber es dem Anschein näch auf etwas weniges ankommt, nemlich, das einer nur zuwege brachte, dass das gewichter, so nieder gehet, weit von der Achse abstehe, wenn es aber weider in die höhe steiget, der Achse oder Linie der Röhe sich nähere, und seine krafft verlöhre. Und hiermit haben sich sehr viel künstler betrogen, die da gemeynet, sie hätten es bey allen 4 zipffeln, und haben darüber viel zeit, kosten, ja offters ehre und Reputation, verlohren. Ja diese Begierde ist noch heut zu tage bey sehr lieben so tieff eingewurtzelt, dass sie sich, todt schlagen liessen, als das sie zugeben, sie wurden selbiges nicht finden ; alleine es kommet meist daher, dass solche Leute kein Fundament in der Mechanic haben vornehmlich aber den Abstandt nicht zu berechnen wissen, und dahero auf ihre blosse

(*Tab. 7.*)

FIG. IX

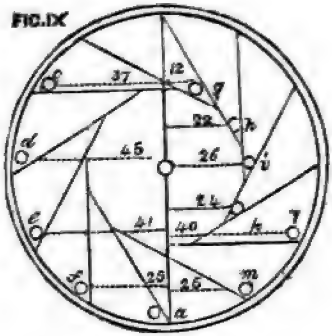


FIG. X.

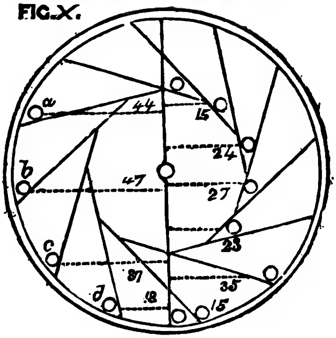
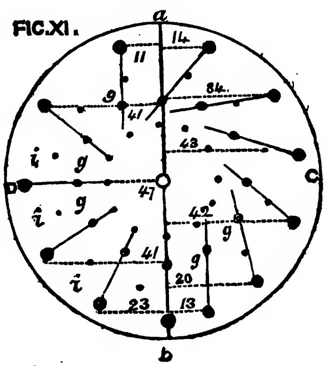


FIG. XI.



einbildung und Gerathewohl lossbauen. Hätten aber solche die Machine fleissig zu Pappier gebracht, und berechnet, wurden sie vieler unkosten seyn uberhoben worden, oder hätten sich nicht so viele jahre, ja fast ihre Lebens-zeit mit einer falschen Hoffnung sich meicheln und schleppen dürffen. Damit aber dergleichen Leute einige Anweisung haben, (als) sind hier zwey bekandte Machinen ein Profil gezeichnet, davon die eine Fig. X., Tab. VII., mit kugeln, die andere aber Fig. XI., mit fallendem Gewichte an einer Achse.

Die gemeldte Machine mit kugeln, so Fig. IX., abgebildet, bestehet aus einem Rad, so wie ein habler schleiff-stein ausstehet, inwendig aber ist solche durch Bretter in 12 Fache eimgetheilet; wie besser aus der Figur, als weits laufftiger Beschreibung zu sehen. In jeden Fachte lieget eine runde metallene Kugel; will man solche berichnen, so giebet man der *machine* eine gewisse Stellung als hier, da unten und oben ein Fach mit der Linie der Röhe schliesset, nemlich bey *a* und *b*, der gleichen auch bey der Horizontal-Linie, so durch die Achse gehet; oder es geschiehet auf die Arth, wie Fig. X., darstelle. Sind die Fache alle richtig aufs Pappier gebracht, so werden die kugeln und ders centra, wie solche von natur liegen, aueh eingetragen, und eine Perpendicular-Linie *a b*, so hier die Linie der Ruhe gezogen. Hier auff wird vom *centro* ieder Kugel eine *horizontale* Leine nach der Linie der Ruhe gezogen (§ 4, 3), welches hier die punctirten Linien sind, und nach einem beliebigen maass staab, so hier M ist, gemessen, und alle die Verhältnisse jeder Leite zusammen addiret, als: die Linie *c* auf der herabsteigenden Seite hat 37 Theile, die Linie *d* 45, die Linie *e* 41, und *f* 26. Thut in Summa: 149. Ferner, die Linien der aufsteigenden Seite, als: *g* 12, *n* 22, *i* 26, *h* 24, *l* 40, und *m* 25. Thut in Summa auch 149: Wenn nun jedes gewicht oder kugel 1 Pfund wieght, und die kugel *d* stehet 42, frey angenommene Theile von der Röhe so bildet man sich ein, dass sie auch 45 Pfund Vermögen habe, hingegen *f* 26 Pfund, weil diese kugel nur 26 Theile abstehet, und so fort mit den (denen) andern, also, dass die krafft aller dieser kugelu *e a e f*, 149 Pfund krafft habe; weil aber die krafft, wenn sie lebendig seyn, and die last wurcklich bewegen soll, mehr vermögen haben muss, als die last, so mussen die gewichter der andern leite nicht so viel gegenstand haben, hier aber findet sich ebenfalls 149, also das beide in *æquilibris* stehen (§ 13) und keines das andere bewegen kann.

Eben dergleichen findet sich auch Fig. X. da die Linie des Abstands *a* 44, *b* 47, *c* 37, und *d* 81, in Summa 146 theil sich befinden, und auf der andern Leite aller 8 kugeln ist die Summa ebenfalls 146: und auf diese weise bleibet es bey allen Standen. Es haben dennoch viele diese art verbessern wollen, und die garden Linien der Fache in krumme Circkel-Linien, und auf mancherley art zugerichtet; allein es ist

einmahl blieben wie das andre, und nicht ein *mobile* sonder *stabille* worden.

Und gesetzt auch, es brachte es einer dahin, dass er etwas mehr krafft erlangte, so wird solche dennoch nicht zulanglich seyn nur die *friction* zu tilgen, geschweige denn aus er es dahin bringen solls, dass die Kugeln zu richter zeit wieder nach dem *centro* lauffen sollten. Weil alle cörper, die in einer runden Bewegung, nach der *peripherie*, und nicht nach dem *centro* eilen. Dahero man ein volles Bier-glass in einem Reiffen sitzen, und solchen über köpff und durch die Beine schwingen kann ohne dass das Glass herab fallet, noch der *liquor* aus dem glass lauffet. Ich habe durch ein *experiment* gewissen, das wenn man ein solches rad schnell beweget, alle kugeln an der *peripherie* liegen bleiben, und keine nach dem *centro* kommt.

Ein ander *perpetuum mobile* gesselt, Fig. XI., Tab. VII., var. Es sey *a b* C D eine Schweibe an einer welle, auf solcher sind 12 kugeln, oder Gewichte von anderer Figur befestiget, doch dass solche an einem arm *c f*, und dieser bey *g* an einem Stifft oder Aohse beweglich. Das kurtze theil *f*, leget sich bey dem hernieder-gehen an einen stifft an, dass er allemahl mit dem *radio parallel* stehet, bey dem Aufsteigen aber hanget er erstlich frey, als bey *n*, hernach aber ruhet er auf einem andern stifft, als *i*, bis er sich, wenn er über *a* heruber ist, auf dem andern schwinget.

Die Berechnung ist mit vorigen gleich, nemlich : Es werden alle Linien des Abstandes vom *centro gravitatis* au bis zur Linie du Röhegemeslsen, und jede Seite *summiret*, da denn die niedergehende leite nach dem maassstab M 163, die auf steigende aber 176, und also noch 13 Theile uber das Æquilibrium hat, und dahero nimmermehr lauffen wird.

Es könnten dengleichen Arthen angufüh073 werden, es ist aber alles vergebliche Arbeit und unkosten, und darbey weiter nichts zu lernen, und bleibet entzwischen eine ausgemachte sache, dass es zur zeit noch nicht möglich durch *mathematische* und *mechanische fundamenta* (so viel uns jetzo bekandt ist) die immer-wahrende bewegung zu erweissen. Ja ich habe beym *experimentiren* gefunden, dass auch ein ziemliches über-gewieht, bloss wegen der *friction*, das sie nicht *præestiren* wollen, da doch die *machine* oder rade mit denen Gewichten nicht uber 40 Pfund schwehr war, auch die zapffen kaum ¼ zoll im *diametro*, der *diameter* des rades aber bey 3 Ellen, und war das ubergewichte bestandig 1 bis 2 pfund, eben dieses hat verursachet, dass ich von meine person meist alle hoffnung fälhren lassen.

Inzwischen halte es doch nicht vor ummöglich, absonderlich weil der Herr Rath *Orffyreus* solches der Welt schon etliche Jahre gezeiget, auch sein Hoch-Furste, Durchl, der landgraf, zu Hessen-Cassel, solches

mit Höhen Fürstlichen wahren Worten durch öffentliches hobes *attestat* bekräftigt als ein Fürst der selbst grosse Erfhalirung und Wissenschaft in *mechanicis* besitzet, und die *structur* des *perpetuum mobilis* genau und wohl *observiret* auch in die zwie monat probem in einem versiegelten zimmer damit machen lassen.

Ubrigens ist allen, so das *perpetuum mobile* noch bestandig suchen, zu hinterbringen:

1. Das sie solches mit den aller *simplesten machinen* thun; denn mehr die *machine* ubersetzet, je mehr sie zapffen, zahne und *materialien* hat, je weniger wird der *motus perpetuus* erhalten werden, und wenn es nicht in der *simplicitat* geschiehet, wird es in *compositione* wohl ewig aussen bleiben.

Ferner (2) dass keiner sich an die Arbeit nach er habe deun seine *invention* auf dem pappier wohl *examiniret*, *friction*, Ruhe, die *centrifugutim*, oder das die Cörper so im Circkel beweget werden, nach der peripherie eilen, den Abstand und alles wohl aus-und abgemessen, und den *calculum* gezogen.

3. Wer diese Berechnung nicht kann, auch *mechanische* fundamente nicht verstehet, gar darvon bleibe, und es andern uberlasse; denner wird nur zeit wird Geld dabeyn verliehren, ja welches das schlimmsteist wenig Ruhe haben Wie ich wiel Exempel auführen könte.

Ob aber gleich unter so viel hundert ja taunsend Suchenden kaum noch einer das *perpetuum mobile* gefunden, so ist dennoch nicht alle Mühe umsonst, weil viele dadurch zur *mechanic* angefuhret worden, die sonsten nicht daran gedacht hätten, oder haben erlernet dass es der Mensch in der *mechanic* nicht höher bringen kann, als Gott. geördnet, und das mit 1 pfund nicht mehr als wieder 1 pfund, ja nicht einmahl beweget, sondern nur *in æquilibrio* kan erhalten werden; so aber mehr damit geschehen soll, auch mehr Raum und Zeit darzn seyn muss. Dahero sind billig diejenigen, welche noch mehr *præstren*, als nach denen fundamenten der *mechanic* wohleingerichtete Künste bereits thun, unter Dr. Bechers weise Narrheît zu zählen. (Pages 25 to 27.)

Das 2. Capitel. Von dem hebel, was selbiger sey? ingleichen von dessen Theilen und Eigenshafften.—[Chap. 11. Von der Schnell-Maage, table VII.]

APPENDIX B.

Eine Mühle durch einen Siphonem zu treiben, zeiget die III. Figur, so aus dem zeisung entlehnet.*

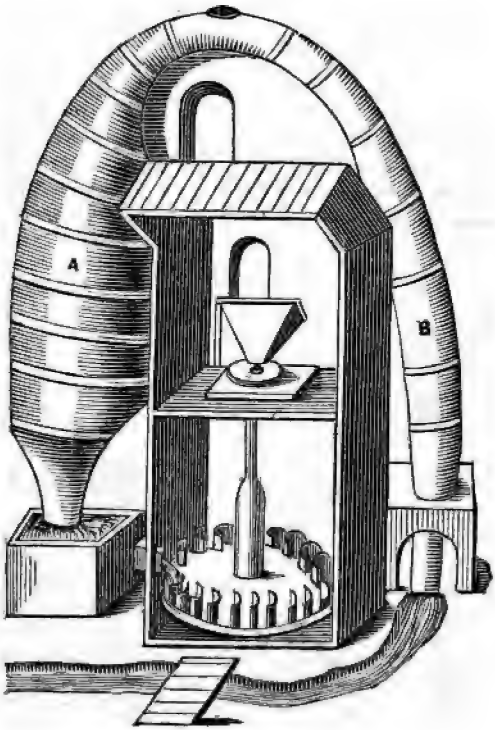
§ 10. Der *inventor* hat hiermit zugleich das *perpetuum mobile* erjagen wollen, weil er vermeynet, der heber lauffe darum, weil er auf der seite A mehr wasser als auf der seite B, und also auch mehr Schwehre habe; darum hat er den Vortheil zu erhalten, und die Röhre des Alblauffs kürtzer zu machen, solche sehr weit angeleget, damit die grosse Menge Wasser in A das wenige in B überwältigen und nach sich ziehen möchte. Wer aber aus der *Mechanica Elementari* gelernet, dass das wasser nicht nàch seiner menge, sondern nach seiner Höhe und Oeffnung, drücket, wird gar bald sehen, dass es Betrug, wodurch aber viele zu kurtz kommen; wie ich denn selber zwey gute stümper gekennet, die sich fast damit *ruiniret* haben. Desswegen ich auch dieses angeführet, und ungescheut davor warnen wollen.

Als dieses geschrieben, so finde No. 102, an. 1719, der Leipsiger Gelehrten neuen Zeitungen aus denen *Transactionibus Philos.* der Engl. Societat, dass Herrn Zurim ein Freund berichtet: Wenn man einem *Siphonem* nehme, davon das ein *Crus* enge das andere weit sey so werde das wasser im engen bis zur Krümmung, im Weiten aber nicht so hoch in die höhe steigen, und also zwischen beyden einen leeren Raum in dem *Siphone* lässet. Wenn man nun das Wasser aus dem Weiten heraus lauffen lasse, werde es im Engen das *vacuum* zu verhüten, nachfolgen, und also ein *motus perpetuus* erfolgen, weil das Weite kürtzer, und also das Wasser wieder ins Gefass lauffen konne. Herr Zurim sagt, er habe solches in der probe falsch gefunden.

Ich halte dafür, dass Zurims Freund das Sinclari Buch de Arte magna et nova gravitatis et levitatis gelesen, also papigna 420 et 440, sehr weitlaufftig von dergleichen heber gehandelt wird, und will der autor, dass es mit dem *Mercurio* geschehen soll. Weil aber besondere Umstande darbey vorfallen, will solches zu einer andern zeit und art gedacht werden.—[Erstes Capitel des Ersten Theils von der Hydraulic. Cap. 1, page 6, paragraph 10.]

* An account of the same, with a folio copper-plate engraving, occurs in Novo Teatro di Machine et Edificie par uarie et sicure operationi. Vittorio Zonca, Architetto. Fol. 1607. P. 115.

(*Tab. 2, Fig. 3.*)

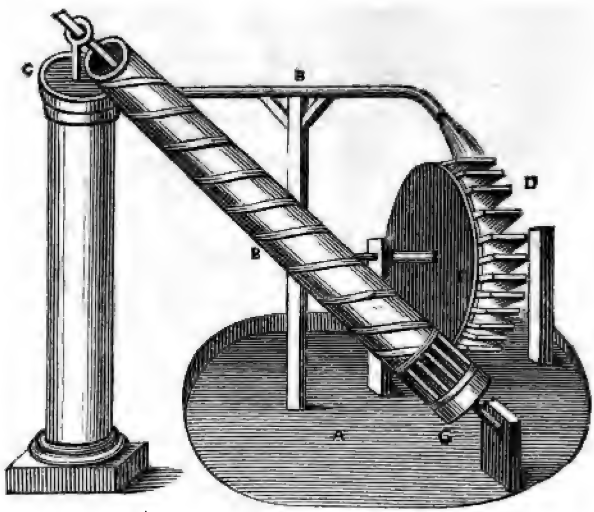


APPENDIX C.

§ 80. Eine Machine mit der Wasser-Schnecke, wodurch man das *Perpetuum Mobile*, machen wollen.

Man hat ein uberschlächtiges Rad gemacht, welches eine Wasser-Schraube, heist und das Wasser aus der Schraube das Rad treiben soll; es ist von vielen mit grossen Ernst und Fleiss gemacht worden, auch nur vor etlichen Jahren von einem *mechanico,* der alle Wissenschafften *in summo gradu* zu besitzen vorgab. Am allerweitläufftigsten handelt

(*Tab.* 17, *Fig.* 1.)



hiervon *P. Mavius Bettinus, in Apiario IV.*, *propos.* 10, *schol. I.*, und *Pater Schotte in Mechanica Hydraulico-Pneumatica,* absonderlich hat dieser *Bettinus* und *Kircherus* solches *præstiren* wollen; aber

Kircherus hat nach vielen *Experimenten* die Unmöglichkeit befunden, ob er schon drey solche Scrauben, soll Hrr. *Professor* Grünberger verfertiget, über einander gesetzet, alleine so balde selbige etliche wohl umgelauffen, hat es der obern an Wasser gemangelt.

§ 81. Ich will die Figur wegen derjenigen die noch diese Stunde ihre Gendancken, es in Stand zu bringen, darauf gerichtet, wie solche *Bettinus in Apiaria IV.*, *Proq. X.*, *p.* 15, und *Pater Scotte* in ob angezogenen Orth *Icon.* 20, p. 333, gezeichnet haben hieher setzen.

A, Fig. 1, Tab. XVII., ist ein Teich oder Kasten mit Wasser, darinnen stehet B die Wasser-Schraube mit dem einen Ende, mit dem andern giesset sich das Wasser aus in Kasten C, welches durch eine Röhre E auf ein überschlächtiges Rad D (so weder von *Bettino* noch Schotten recht gezeichnet) fallet, welches durch das an seiner Welle steckende Kamm-Rad F vermittelst des Getreches G die Scraube B treiben, und also einen *continuielichen motum* verursachen soll. Es verneynet zwar *Bettinus* und andere mit ihm : das Wasser steige leichter in der Scraube als in andern pumpen oder *Machinen*, weil das Wasser sich gleischsam in der Scraube ohne sonderliche pressung fortwältzete. Allein, ob es schon scheinet dass die Scraube leichter zu bewegen als eine Pumpe, so will es auch hingegen desto mehr zeit haben.

Wer eine rechte probe von der Wasser-Schraube haben will, denn will eine *Machine* hierzn anweisen.—[Chap. 4, par. 180-81, page 43.]

APPENDIX D.

Demonstration de l'Impossibilité du Mouvement Perpétuel, envoyée comme il s'ensuit à l'Auteur du Journal, par M. de la Hire, à l'occasion de plusiers de ces mouvements qui ont paru depuis peu.

Il n'y a personne de ceux qui prétendent avoir trouvé le mouvement perpétuel, qui ne demeure d'accord que deux poids étant en disposition de se mouvoir suivant leur direction naturelle, dans des temps ou par des chemins qui soient en raison réciproque de leur pesanteur demeureront en équilibre. Cependant il n'y a point de mouvement perpétuel dont on ne puisse tirer une conclusion fort opposée à ce principe; car de quelle manière qu'on le puisse prendre, ce n'est qu'une elevation d'un poids à une certaine hauteur par la descente d'un autre poids dans un même temps, & réciproquement la restitution du premier au lieu où il étoit avant son mouvement par la descente de celui qui a été élevé, & ainsi à l'infini, soit par le moyen de quelques autres poids, qui etant élevée, agissent dans leur chûte sur d'autres ou sur des corps liquides, soit par le moyen de quelques corps liquides qui étant élevée peuvent couler & agir sur des parties fort éloignées du centre du mouvement, dont on ne peut tirer aucun avantage, ce qui est entierement contraire au principe précedent. 1678, p. 304.

Ceux qui s'occupent à cette recherche embarrassent pour l'ordinaire leurs machines de tant de poids & de mouvements, qu'ils oublient toujours à prendre garde à quelqu'une des circonstances du temps, de la hauteur & des forces agissantes, ou de leur direction, qui y sont quelquefois si fort mêlées toutes ensemble, qu'il faudroit un très-grand travail pour les bien distinguer. C'est ce qui les conduit à une fausse démonstration du mouvement perpétuel; & quand ils proposent leurs belles inventions à ceux qui sont versée dans les sciences, & qui ne peuvent pas sur le champ leur faire connoître en quel lieu se recontre la fausseté de leur raisonnement, ils publient partout que les plus habiles out été convaincus de la verité de leur mouvement perpetuel.—Memoires de l'Academie Royale des Sciences; Depuis 1666, jusqu'a 1699. A Paris, 1730, 4to. [vol. X., page 605].

Note.—The first ten volumes of this edition comprise an epitome of Memoirs dating from 1666.

APPENDIX E.

Montucla Histoire des Mathématiques.

Du mouvement perpétuel. Le mouvement perpétuel est une chimère assez ancienne et assez célèbre dans la mécanique, pour que nous devions en parler dans cet ouvrage. On entend par mouvement perpétuel un mouvement qui se conserve et se renouvelle continuéllement de lui même sans le sécours d'aucune cause extérieure, ou une communication non-interrompue du même degré de mouvement qui passe d'une partie de matière à l'autre, soit dans un cercle, soit dans une autre courbe rentrante en elle-même, de sorte que le même mouvement revienne au premier moteur sans avoir été altéré. (*Encyclopedie, au mot Perpetuel.*) Mais on a fait beaucoup de découvertes réelles en courant après un chimère. On peut voir à ce sujet les *Recreations Mathematiques,* edition de Montucla. On trouve des propositions de mouvement perpétuel dans le *Journal des Savans*, 1678, p. 165 ; 1686, p. 9, 29, 95, 104 ; 1700, p. 245 ; 1726, p. 590 ; 1745, p. 29. Nous parlerons ci-après d'une des machines, fruit des efforts qu'on a faits pour résoudre ce problême, à cause du bruit qu'elle fit parmi les savans ; mais toutes ont avortè. C'est aussi plutôt une insulte qu'un éloge de dire de quelqu'un qu'il cherche le mouvement perpétuel ; l'utilité des efforts que l'on a faits jusqu'ici pour la trouver, donnent une idèe peu favorable pe ceux qui s'en occupent.

Parmi toutes les propriétès de la maitière et du mouvement, nous n'en connaisons aucune qui paraisse pouvoir être le principe d'un tel effet.

On convient que l'action et la réaction doivent être égales, et qu'un corps qui donne du mouvement à une autre doit perdre ce qu'il en communique. Or, dans l'état présent des choses, la résistance de l'air, les frottemens, doivent nécessairement retarder sans cesse le mouvement.

Ainsi, pour qu'un mouvement quelconque pût subsister toujours, il faudroit où qu'il fût continuellement entrétenu par une cause extérieure; et ce ne seroit plus alors ce qu'on entend par le mouvement perpétuel

ou que toute resistance fût anéantie, ce qui est physiquement impossible. Par une autre loi de la nature, les changemens qui arrivent dans le mouvement des corps sont toujours proportionnels à la force matrice qui leur est imprimée, et sont dans la même direction que cette force: ainsi une machine ne peut recevoir un plus grand mouvement que celui qui rèside dans la force matrice qui lui a été imprimée. Or, sur la terre que nous habitons, tous les mouvements se font dans un fluide resistant, et par conséquent ils doivent nécessairement être retardés; donc le milieu doit absorber une partié considérable du mouvement.

Le frottement doit diminuer peu-à-peu la force imprimée, ou communiquée à la machine; de sorte que le mouvement perpétuel ne sauroit avoir lieu, à moins que la force communiquée ne soit beaucoup plus grande que la force géněratrice, et qu'elle ne compense—la diminution que toutes les autres y produisent; mais comme rien ne donne ce qu'il n'a pas, la force génératrice ne peut donner à la machine un degré de mouvement plus grand que celui qu'elle a elle-même; ainsi, toute la question du mouvement perpétuel en ce cas, se réduit à trouver un poids plus pesant que lui-même, ou une force elastique plus grande qu'elle-même.

On peut dire aussi qu'il faudroit trouver une méthode de gagner par la disposition et la combinaison des puissance mécaniques, une force équivalente à celle qui est perdue. C'est principalement à cé dernier point que s'attachent ceux qui veulent résoudre ce problême: mais comment et par quels moyens, peut on regagner une telle force.

Il est certain que la multiplication des forces ou des puissances ne sertent de rien pour cela: car, ce qu'on gagne en puissance est perdu en temps; de sorte que la quantité de mouvement demeure toujours la même.

Jamais la mécanique ne saurait faire qu'une puissance plus petite, soit réellement égale à une plus grande; par example, que 25 livres soient équivalentes à 100. S'il nous paroît qu'une puissance moindre soit équivalante à une plus grande, c'est une erreur de nos sens. L'equilibre n'est pas véritablement entre 25 et 100 livres mais entre 100 livres qui se meuvent ou tendent à se movoir avec une certaine vîtesse, et 25 livres qui tendent à se mouvoir avec quatre fois plus de vîtesse que les 100 livres.

Quand on considère les poids de 25 et 100 livres comme fixes et immobiles, ou peut croire d'abord que les 25 livres seules empêchent un poids beaucoup plus grand de s'élever. Mais on se détromp bientôt si l'on considére l'un et l'autre poids en mouvement; car on verra que les 25 livres ne peuvent élever les 100 livres qu'en parcourant dans le même temps un espace quatre fois plus grand. Ainsi, les quantités

virtuelles de mouvement de ces deux poids seront les mêmes, et par conséquent il n'y aura plus rien de surprenant dans leur équilibre.

Une puissance de 10 livres étant donc mue, ou tendant à se mouvoir avec dix fois plus de vîtesse qu'une puissance de 100 livres, peut faire équilibre à cette dernière puissance ; et ou on peut dire autant de tous les produits égaux à 100 livres. Enfin, le produit de part et d'autre doit toujours être de 100, de quelque manière qu'on s'y prenne ; si on diminue la masse, il faut augmenter la vîtesse en même raison.

Cette loi inviolable de la nature ne laisse autre chose à faire à l'art que de choisir entre les différentes combinaisons qui peuvent produire le même effet.

Maupertius, dans ses lettres sur différens sujets de philosophie, fait les réflexions suivantes sur le mouvement perpétuel. Ceux qui cherchent ce mouvement excluent des forces qui doivent le produire non-seulement l'air et l'eau, mais encore quelques autres agens naturels qu'on y pourroit employer. Ainsi ils ne regardent pas comme mouvement perpétuel, celui qui seroit produit par les vicissitudes de l'atmosphère, ou par celles du froid et du chaud. Ils se bornent à deux agens, la force d'inertie et la pesanteur, et ils réduisent la question à savoir si l'on peut prolonger la vîtesse du mouvement, ou par le premier de ces moyens, c'est-à-dire, en transmettant le mouvement par des chocs d'un corps à un autre, ou par le second, en faisant remonter des corps, par la descente d'autres corps qui, ensuite remonteront eux-mêmes, pendant que les autres descendront. Dans se second cas il est démontre que la somme des corps, multipliés chacun par la hauteur d'où il peut descendre est égale à la somme de ces mêmes corps multipliés chacun par la hauteur où il pourra monter. Il faudroit donc pour parvenir au mouvement perpétuel par ce moyen, que les corps qui tombent et s'élèvent conservassent absolument tout le mouvement que la pesanteur peut leur donner, et n'en perdissent rien par le frottement ou par la résistance de l'air, ce qui est impossible.

Si on veut employer la force d'inertie, on remarquera que le mouvement se perd dans le choc des corps durs ; et que si les corps sont élastiques, la force vive à la vérité se conserve ; mais outre qu'il n'y a pas de corps parfaitement élastiques, il font encore faire abstraction ici des frottemens et de la résistance de l'air ; d'où Maupertius conclut qu'on ne peut espérer de trouver le mouvement perpétuel par la force d'inertie, non plus que par la pesanteur, et qu'ainsi ce mouvement est impossible.

Il se répandit en 1700 un bruit que le mouvement perpétuel étoit trouvé. On le voyoit dans un lieu où la difficulté de la chose n'etoit pas bien connue, où l'invention n'étoit pas discutée comme elle l'été dans une académie, où un air de science réussit quelquefois, et l'air de

confiance presque toujours. Sauveur l'expliqua à l'Académie qui en fut fort surprise; et peu de temps après le mouvement perpétuel disparut avec son auteur. A cette occasion Parent prouva l'impossibilité par cette seule raison que toutes les parties d'une machine ont un centre de gravité commun que pendant qu'elles tournent autour d'un axe ou d'un point fixe; quel qu'il soit, ce centre de gravité commun se trouve nécessairement dans une situation, où il est plus bas qu'en toute autre, et qu'aussitôt tout doit s'arrêter. Car, puisqu'il y a un point oú la force que plusieurs corps ont pour descendre est réunie toute entière, dès que ce point ne peut plus descendre, il faut que tous ces corps demeurent immobiles. Parent détérmina en général quel devoit être ce point de repos inévitable pour toutes les machines possibles.—[Hist. Acad., 1700, page 156.]

On trouve dans les *Œuvres Philosophiques de 'sGravesande*, publiées à Amsterdam en 1774, la relation d'une machine d'Orffyreus construite en 1715, et qui fit du bruit en Europe. On l'appela aussi la roue de Cassel; et voici ce qu'il en dit dans une lettre à Newton, tome 1, p. 303.

J'ai cru que vous ne seriez pas fâché d'avoir une relation un peu détaillée de ce qu'on observe dans un examen extérieur d'une machine sur laquelle les sentimens sont si partagés, et qui a contre elle presque tous les habiles mathématiciens. Un très-grand nombre soutient l'impossibilité du mouvement perpétuel, d'où est venu le peu d'attention qu'on a fait à la machine d'Orffyreus. Je sais combien je suis inférieur à ceux qui ont donné leurs démonstrations sur l'impossibilité de ce mouvement; cependant pour vous expliquer les sentimens avec lesquels j'ai examiné cette machine, j'aurai l'honneur de vous dire qu'il y a environ sept ans que je crus découvrir le paralogisme de ces demonstrations, en ce qu'elles ne peuvent êpre applicables à toutes les machines possibles; et depuis je suis toujours resté très-persuadé qu'on peut démontrer que le mouvement perpétuel n'est pas contradictoire; il m'a paru que Leibnitz avoit tort de regarder comme un axiôme l'impossibilité de ce mouvement; ce qui sert néanmoins de fondément à une partie de sa philosophie. Malgré cette persuasion, j'étois fort eloigné de croire qu' Orffyreus fût assez habile pour découvrir le mouvement perpétuel. Je regardais ce mouvement comme ne devant être découvert qu'apres plusieurs autres inventions, au cas qu'il le fût jamais. Depuis que j'ai examiné la machine, je suis dans un étonnement que je ne saurois exprimer. L'auteur a du genie pour les mécaniques, mais n'est rien moins que profond mathématicien, cependant cette machine a quelques chose de surprénant, quand ce seroit une fourberie. Voici ce qui regarde de la machine même, dont l'auteur ne laisse voir que l'extérieur, de peur qu'on lui vole son secret. C'est un tambour d'environ 14 pouces d'épaisseur sur 12 pieds de

diamètre; il est très-léger, étant fait de quelques planches assemblées par d'autres pièces de bois, de manière qu'on verroit l'intérieur de tous côtés sans une toile cirée qui couvre tout le tambour. Ce tambour est traversé d'un axe d'environ six pounces de diamétre, terminé par les extrémités par des axes de fer de trois quart de pouce, sur lesquels la machine tourne. J'ai examiné ces axes, et je suis très-persuadé qu-il n'y a rien en dehors qui contribue au mouvement de la machine. J'ai tourné le tambour fort lentement, et il est resté en repos, aussitôt que j'ai retira la main; je lui ai fait faire un tour ou deux de cette manière; ensuite je l'ai fait mouvoir tant soit peu plus vîte; je lui ai fait faire un tour au deux; mais alors j'etois obligé de la retenir continuellement; car l'ayant lâché il a pris en moins de deux tours sa plus grande célérité, de maniére qu'il a fait vingt cinqà-vingt-six tours dans une minute. C'est le mouvement qu'il a conservé ci-devant pendant deux mois, dans une chambre cachetée, dans laquelle il etoit impossible qu'il y eût aucune fraude. Le prince fit ouvrir la chambre, et arrêter la machine après ce temps-la; car, comme ce n'est qu'un essai, elle n'est pas assez forte pour que les matériaux ne s'usent pas par une longue agitation.

Le Landgrave a été présent à l'examen que j'ai fait de la machine. J'ai pris la liberté de demander au prince qui a vu l'intérieur du tambour, si lorsque la machine a été agitée pendant un certain temps, rien n'étoit changé dans l'intérieur; comme aussi s'il n'y avoit pas quelques pièces dans lesquels on pourroit soupconner de la fraude; le prince m'a assuré que non, et que la machine est fort simple.* Vous voyez monsieur, que je n'en ai pas assez vu par moi même pour assurer que j'ai une demonstration, que dans cette machine a la principe du mouvement, qui est certainment dans le tambour, soit tel qu'il le faut pour rendre le mouvement perpétuel; mais aussi je crois qu'on ne sauroit me nier d'avoir des présomptions fortes en faveur de l'inventeur. Le Landgrave a donné une récompense digne de sa générosité à Orffyreus, afin de voir le secret de la machine, avec promesse de ne se point servir du secret, ni de la découvrir avant que l'auteur en eût retiré encore d'autres récompenses pour rendre son invention publique, je sais très bien monsieur, qu'il n'y a que l'Angleterre où les sciences fleurissent assez pour faire trouver à l'auteur une récompense digne de son invention. Il s'agit simplement de la lui assurer, en cas que sa machine soit un véritable mouvement perpétuel, l'auteur ne demande à toucher l'argent qu'après que la machine aura été examinée en dedans; on ne sauroit raisonnablement exiger cet examen avant la récompense

* Comment le charlatan n'en auroit-il pas imposé au prince, puisqu'il a imposé au physicien?

promise. Comme il s'agit d'une chose untile au public, et à l'avancement des sciences, de découvrir l'invention ou la fraude, j'ai cru que cette relation ne vous seroit pas désagréable.

On fut fort étonné que ce célèbre physicien trouvât que le mouvement perpétuel n'étoit pas demontré impossible: apres divers raisonnemens, pour tâcher de le prouver, il finit par dire: il seroit à souhaiter que la forte persuasion dans la quelle sont les mathématiciens, touchant cette impossibilité, ne les empèchât pas de faire une attention sérieuse à une machine aussi étonnante que celle de Cassel. Une roue dont le principe du mouvement est intérieur, qui se met en mouvement par le moindre effort, qu'on peut faire tourner du côté qu'on juge à propos, sans que ce qui la fait tourner d'un côté soit arrêté par ce qui l'auroit fait tourner de l'autre, si elle y avoit été poussée. Enfin, une roue qui, après avoir fait quelques millions de tours avec une rapidité surprenante, continue son mouvement de même, et n'est arrêtée qu'à force de bras. Une telle machine mérite, a ce qu'il me paroît, quelque éloge, quand même elle ne satisferoit pas à tout ce que l'inventeur en promet. Si c'est le mouvement perpétuel, l'auteur mérite bien la récompense qu'il demande: si ce ne l'est point, le public peut découvrir une belle invention, sans que ceux qui auroient promis la récompense fussent engagés à rien, l'inventeur n'ayant jamais exigé qu'une promesse (tome 1, p. 315). Voyez aussi la vie de 's Gravesande, par Allamand, à la tête de cet ouvrage, où l'on prétend que la servante déposa qu'elle faisoit tourner la machine étant placée dans une chambre voisine; qu'Offyreus étoit un fou; que l'opinion qu'on avoit de la machine avoit bien changé; cependant on voit que Jean Bernoulli croyoit au mouvement perpétuel. Opera, tome 1, page 41. [See Appendix H.]

L'année suivante 1716, Wolf publia son Dictionnaire Mathématiques, et au mot Perpétuel il rapporte les argumens de Sturm, Lorini, Stévin et Leibnitz pour en prouver l'impossibilité, il dit que quoiqu'on ne trouve pas jusqu'à présent aucune raison forte pour ne pas ajouter foi au serment d'Orffyreus que la roue puisse conserver toujours le mouvement qu'on lui a communiqué sans effort; il n'est pourtant pas prouvé qu'il n'y ait pas une matière fluide invisible qui influe sur ce mouvement. L'examen qu'en fit 's Gravesande mit Orffyreus dans un si grande colère, qu'il brisa sa machine le jour même, comme on le voit dans les *Annal. Physico-Med. de Breslaw,* imprimées à Leipzig et à Budissin, en 1723, in 4to, p. 427, et dans la vie de 's Gravesande; il écrivit sur la muraille que c'étoit l'impertinente curiosité du professeur qui en étoit la cause; cela sembla indiquer qu'il redoutoit un examen ultérieur. Au reste, 's Gravesande n'a jamais avoué qu'il eût été si grossièrement trompé. Dans le temps la roue de Cassel faisoit tant de bruit, il parut une dissertation de David Gottlob Diez, *Perpetuum mobilis*

mecanici impossibilitas methodo mathematica. Il fait voir que les mouvemens perpétuels du jesuite de Lanis, de Cornelius Drebble, de Becher, de Jérémie Mitz de Bâle sont des chimères. Dans son théorème XLI. on trouve cette assertion: *Perpetuum mobile Orffyreum ex descriptione ejus propria aestimatum impossibile est.*

Peiresc et Kepler n'étoient pas aussi crédules que 's Gravesande; au sujet du mouvement perpétuel que Drebble, le premier écrit à son ami Camden que l'on ne croit pas légèrement dès deçà (*G. Camdeni Epistolae. Londini*, 1691, pp. 333 et 387). Kepler écrivoit à ce même sujet en 1607: *si creare possit antmam quae instiumena ejus sine ponderibus aliosque motus elementares moveat, et in motu conservet tunc mihi erit magnus* Apollo. (Kepl. épist. 1718: p. 393.)

M. le baron de Zache, dans des écrits sur le mouvement perpétuel, *Reichs-Anzeiger*, 1796, 6 juin et 17 novemb.) a fait des recherches curieuses à ce sujet, relativement aux différentes inventions données pour mouvement perpétuel. Je finirai en indiquant un dernier ouvrage à ce sujet: Lecture on the Perpetual Motion, Henrich. London, 1770.

Malgré les raisonnemens de 's Gravesande, l'on a continué de regarder le mouvement perpétuel comme impossible. L'Académie des Sciences de Paris prit en 1775 la résolution de ne plus examiner aucune machine annoncée comme un mouvement perpétuel, et l'Académie crut devoir rendre compte des motifs qui l'avoient déterminée, dans l'Histoire de l'Académie de 1775, p. 65.

La construction d'un movement perpétuel, dit l'historien, est absolument impossible: quand même le frottement, la resistance du milien ne dédruiroient point à la longue l'effet de la force matrice. Cette force ne peut produire qu'un effet égal à la cause; si donc on veut que l'effet d'une force finie dure toujours, il faut que cet effet soit infiniment petit dans un temps fini. En faisant abstraction du frottement et de la résistance, un corps à qui on fais imprimé une mouvement le conserveroit toujours; mais c'est en n'agissant point sur d'autres corps, et le seul mouvement perpétuel possible, dans cette hypothèse, qui d'ailleurs, ne peut avoir lieu dans la nature, seroit absolument inutil à l'objet que se proposent les constructeurs des mouvement perpétuels: ce genre de recherches a l'inconvénient d'être coûteux; il a ruiné plus d'une famille, et souvent des mechaniciens qui eussent pu rendre de grands services, y ont consumé leur fortune, leur temps et leur génie.

Tout attachment opiniâtre à une opinion démontrée fausse, s'il s'y joint une occupation perpétuelle du même objet, une impatience violente de la contradiction, est sans doute une véritable folie. On ne la regarde point comme telle, si l'opinion qui forme cette folie ne choque pas les idées communes, si elle n' influence sur la conduite de la vie, si elle troubles pas l'ordre de la société.

Mais au moment où ce-ci s'imprime, je vois que le 6 janvier, on a présenté à Londres une pétition pour un nommê Dupré qui a découvert le mouvement perpétuel, et que la petition est datée du 5 jour du mouvement perpétuel.*

* Histoire des Mathématiques, par J. F. Montucla. Achevé et publié par Jérôme De la Lande. Paris, 1802. 4 vols. 4to. [Vol. 3, pp. 813-820.]

APPENDIX F.

Œuvres Philosophiques de 's Gravesande.—Remarques touchant le Mouvement Perpétuel.

Il y a environ huit mois que j'examinai à Cassel, par ordre de S.A.S. Monseigneur le Landgrave de Hesse, les effets d'une machine, que l'inventeur assure être un mouvement perpétuel. Il en cache avec soin l'interieur, jusques à ce, (dit-il,) qu'on lui ait assuré une récompense, qu'il ne demande de toucher, que lorsque son invention aura été examinée, et reconnue par les mathématiciens pour être ce qu'on apelle en mécanique le mouvement perpétuel. Je fus frappé des effets de la machine; et ce que j'en vis, joint à ce que j'en appris, d'une manière à ne pouvoir être révoqué en doute, il me faut regarder cet machine comme une des plus belles inventions en mécanique dont j'aie connoisance, à ne considérer que les effets avérés.

Le désir de faire connoître cette machine, fondé sur la persuasion de l'utilité qu'on pourroit en retirer, même en supposant fausse la pretension de l'auteur, me fit écrire à Monsieur Newton ce que j'avois observé. Ma Lettre a été imprimée en François, et aussi en Anglois, à ce que j'ai appris, n'ayant jamais vu cette traduction.

On a trouvé à redire que j'avance dans cette Lettre, que je ne crois pas le mouv. perp. contradictoire.

Que les démonstrations qu'on a données de son impossibilité ne me paroissent pas applicables à toutes les machines qu'on pourroit imaginer.

Et enfin, que je trouvois probable que la machine de Cassel fut un véritable mo. per.

Tout la difficulté roule sur la première de ces trois propositions. Si elle étoit prouvée, les deux dernières n'auroient pas grand difficulté. Aussi a-t-on trouvé cette première proposition trop hardie pour être avancée sans preuve; ce que j'accorde très-volontiers: je n'aurois pas fait cette faute, si ma Lettre avoit été écrite pour être imprimée, mais elle étoit adressée à Monsieur Newton.

J'étois si peu disposé à avancer cette proposition sans preuve, que je ne me suis jamais déclaré sur ce que je pensois sur le mo. per., prévoyant le jugement que les mathématiciens devoient faire de celui qui, sur ce sujet, s'écarteroit du sentiment reçu.

Ce que j'ai cru devoir à la verité, après avoir vu la machine de Cassel, m'a engagé de dire à Monsieur Newton ce que je pensois sur cette machine, et à cette occasion ce que je pensois des preuves de l'impossibilité du mo. per. Ma Lettre a été imprimée; il faut me justifier devant le public: j'aurois même dû le faire plûtot.

Avant d'entrer en matière, il faut établir l'état de la question. On apelle en mechanique mo. per., une machine dont le principe du mouvement ne s'arréteroit j'amais si les matériaux ne s'usoient pas.

On voit par cette définition, qu'une horloge, qui se monteroit par le vent; par les changemens que l'humidité et la sécheresse, ou le froid et le chaud, produisent dans certain corps; ou enfin par les changemens dans le poids de l'atmosphère, ne seroit pas un mo. per. Il ne seroit pourtant pas difficile de construire une telle horloge, qui ne pourroit s'arrêter que par quelque dérangement dans ses parties; mais ce serait des *agents* étrangers qui feroient mouvoir la machine.

Il faut examiner à présent si la possibilité du mo. per. n'est pas une suite de ce que les mathématiciens ont enseigné sur le choc. Il semble qu'une partie de ceux qui ont voulu prouver l'impossibilité d'un tel mouvement, n'aient pas fait attention aux effets du choc.

Les mathématiciens, et les physiciens, sont partagés sur la force du choc. Les uns croient, et c'est le sentiment le plus ordinaire, que les forces de différents chocs d'un même corps sont entre elles; comme les vîtesses de ce corps. Les autres, au contraire, soutiennent que ces mêmes forces sont entre elles comme les quarrés des vîtesses. Tous conviennent que la force du choc est proportionelle à la masse; c'est pourquoi les premiers multiplient la mass par la vîtesse, pour avoir la force du choc; les autres multiplient la mass par le quarré de la vîtesse, pour determiner cette même force.

Je n'examinerai pas ici lequel de ces deux principes est juste: 1. Qu'en admettant le premier il faut admettre la premier possibilité du mo. per. dans les machines qui auront pour principe de leur mouvement le choc des corps. 2. Qu'en admettant le second principe, l'impossibilité du mo. per. n'a pas encore été démontrée dans tous les cas possibles. Et 3. Enfin, je tâcherai de faire voir que les loix de la nature ne nous sont pas assez connues pour en tirer une conclusion générale, que le mo. per. est contraire à ces loix.

I. Preuves de la possibilité du Mo. Per., en supposant que la Force du corps en mouvement est proportionelle à la masse multipliée par la vîtesse.

Ceux qui admettent ce principe conviennent de cette proposition; que la force d'un corps qui tombe librement, s'augmente en raison du tems que le corps dans sa chute reste exposé à l'action de la pesanteur: ce qui est une suite du principe; puisqu'il est constant par l'expéri-

ence, que la vîtesse d'un corps qui tombé, s'augmente en raison du tems de la chûte.

Par la même raison, un corps qui monte verticalement, perd de sa force en raison du tems qu'il monte: par conséquent, si de deux corps égaux l'un monte verticalement, pendant que l'autre tombe librement, le premier perdra autant de force que le second en gagne, quoi qu'ils parcourent des espaces inégaux.

La force qu'il faut pour faire monter un corps à une certaine hauteur, est celle qu'il faut pour surmonter l'action de la pesanteur, pendant que le corps monte; & cette force est proportionelle au tems que le corps emploïe à monter.

Si donc un corps, en tombant librement d'une certaine hauteur, peut rester exposé plus long-temps à l'action de la pesanteur, qu'il ne l'est en remontant à la même hauteur, la force qu'il acquiert en tombant surpasse celle qui le faire remonter. Comme il est très possible qu'un corps remonte plus vite qu'il n'est descendu, c'est sur quoi je fonde ma preuve de la possibilité du mo. per.

Concevons un corps qui en tombant de la hauteur d'un pied perde tout son mouvement par le choc; posons qu'il tombe quatre fois de suite de la même manière: il sera descendu de la hauteur de quatre pieds, & les quatre chocs seront égaux à la force, que la gravité communique au corps pendant les quatre momens de sa chute. Mais il est connu que le corps peut remonter en deux de ces momens à la hauteur de quatre pieds; et par conséquent la force de deux des quatre chocs suffit pour le faire remonter, & les deux autres chocs pourront être employées à faire mouvoir une machine, dont le mouvement sera continué à perpétuité par des chûtes réiterées du même corps, qui à chaque révolution gagne la force de deux chocs. Le gain de la force sera plus grand à chaque révolution, si on augmente le nombre des chocs dans la descente. Il ne s'agit pas ici de la manière d'appliquer l'effort des deux chocs qu'il faut pour faire remonter le corps: je ne dis pas que j'aie trouvé le mo. per.; il suffit de démontrer, comme je viens de le faire, qu'il y a dans la nature un principe d'augmentation de force, pour soutenir que le mo. per. n'est pas contradictoire, & même qu'il est possible.

Cette possibilité pariôtra plus clairement, si on fait attention à cette propriété des ressorts, qu'ils se débandent avec la même force qu'ils ont été bandés, sur quelque corps qu'ils agissent. Soient deux corps que je nomme A & B. Je suppose que A pése quatre livres, & B une livre. B en descendant de la hauteur de quatre pieds fait monter A à la hauteur d'un pied, par le moyen d'un levier ou de quelque autre machine; ce qui n'est pas contesté. Je nomme un la vîtesse qu'un corps acquiert en tombant de la hauteur d'un pied à laquelle il vient d'être

élevé : il aura quatre dégrés de force. Supposons encore que A par son choc bande un ressort, et qu'il y employé toute la force de son choc. Si ce ressort en se débandant agit sur B ; il communiquera à B quatre dégrés de force : c'est à dire, puisque la masse de B est un, quatre dégrés de vîtesse, qui feront remonter le corps B à une hauteur de seize pieds, quadruple de la hauteur dont il étoit descendu d'abord.

On trouve dans les Actes de Leipsic une dispute sur cette matière entre MM. Leibnitz et Papin. Le premier, pour combattre le principe, que la force d'un corps est proportionelle à sa vîtesse, soutenoit que la possibilité du mo. per. en est la suite. M. Papin ne put nier la validité de la conséquence, et se contenta de répondre, que si' on lui faisoit voir, qu'il n'est pas contradictoire que toute la force d'un grand corps soit communiquée à un petit, il avoueroit, ou que le principe qu'il défendoit est faux, ou que le mouvement perpétuel est possible. M. Leibnitz à cette occasion indiqua plusieurs moyens de communiquer toute la force d'un grand corps à un petit, differents de celui du ressort que j'ai emploié dans ma demonstration.

Le ressort des corps est un principe d'augmentation de force a l'infini en supposant toujours, avec les plus grand nombre des Mathématiciens, que la force du corps est proportionelle au produit de la masse par la vîtesse.

Concevons onze boules de quelques matière flexible à ressort, dont les masses soient en progression géometrique d'un à dix ; que ces boules soient rangées suivant l'ordre de leur grandeur ; que la plus petite, que nous supposons seule en mouvement, frappe celle qui la suit ; que celle-ci, mise en mouvement par ce choc, aille frapper la suivante ; & ainsi de suite, jusques à ce que plus grande soit frappée. Dans ce cas, si tous les chocs sont directs, & si le ressort des boules est parfait, cette dernière aura 394. fois plus de force que n'en avoit la plus petite ; comme on le trouve par les régles du choc, recuës par tous les Mathématiciens, qui n'ont point de différent sur la vîtesse des corps après le choc. Les dix premières boules retournent, & les forces de toutes jointes ensemble surpassent 393. fois la force communiquée à la petite boule qui avoit été mise en mouvement. Or, comme la direction du mouvement n'empêche pas que l'effort des ces corps ne puisse être mis à profit, il s'ensuit qu'un seul dégré de force communiquée à un corps, en produit près de huit cens dans d'autres corps.

Soutiendra-t-on que ces huit cens dégrés de force ne puissent être emploiés à en rendre un seul au premier corps, & outre cela à faire mouvoir quelque Machine, dont on voit aisément que le mouvement pourroit être continué à perpétuité, si les matériaux ne susoriaent pas?

On m'objectera, peut-être, qu'il n'y a point de corps, dont le ressort soit parfait ; ce qui ne renverse pas la force du raisonnement. De manque

de perfection dans le ressort, il suit que l'augmentation de la force sera moindre, que celle que nous avons déterminée; mais, il faudroit n'y ent du tout points de ressort, pour qu'il n'y cut d'augmentation de force. L'élasticité de l'yvoire, qui n'est pas la plus parfait que nous ayons, est suffisante pour augmenter la force plus de dix cens fois, dans l'exemple qu'on vient d'alléguer.

Le seul moyen de répondre aux argumens qu'on vient de proposer pour la possibilité du mo. per., est de nier, avec M. Leibnitz, le principe sur lequel ils sont fondés, que les forces des corps sont en raisons des produits de leurs masses par leurs vîtesses; mais, c'est ce qu'un très petit nombre de Mathématiciens ont fait jusqu'ici. Dans le tems que j'écrivis ma Lettre à M. Newton, je croyois avoir des preuves du principe sur lequel j'ai raisonné jusqu'à présent; & en admettant le principe, il me paroissoit que la conséquence étoit démontrée. Si je me suis trompé dans principe, je suis trombé dans l'erreur avec le plus grand nombre de ceux qui trouvé que j'avois tort dans ce que j'ai avancé touchant le mo. per.

II. Examen des Demonstrations de l'impossibilité du Mouvement Perpétuel, en posant pour principe, que la force d'un corps est proportionelle au quarré de sa vîtesse.

Une suitfort naturelle de ce principe est que la force qu'un corps acquiert en tombant est exactement celle qu'il faut pour le faire remonter à la même hauteur, sans qu'on doive avoir égard-au tems.

C'est encore une suite du même principe, que la force n'est pas augmentée dans le choc des corps flexibles à ressort: & j'accorde volontiers, qu'à cet égard, ceux qui admettent le principe dont il s'agit, ont démontré l'impossibilité du mo. per.

Mais, il suit aussi du même principe, que deux corps, qui se choquent directement, peuvent rester en repos après le choc, quoique leurs forces soient inegales; car deux corps inegaux, dont les vîtesses sont en raison inverse des masses, et dont par conséquent les forces sont inégale, venant à se choquer directement, s'ils n'ont point de ressort, restent en repos après le choc: ce que personne ne conteste, et ce qui est prouvé directement par des expériences dans lesquelles il n'est pas possible qu'il y ait de l'erreur.

Concevons deux corps dont les masses soient comme 1 à 10 & les vîtesses comme 10 à 1: la force du petit sera cent, & celle du grand sera dix, en multipliant les masses par les quarrés des vîtesses, c'est à dire, que la force du petit corps surpasse dix fois l'autre, & cependant la force du grand corps est suffisante pour fair perdre au petit corps tout son mouvement. C'est un axiome reçu de tous les Mathématiciens qu'il faut autant d'effort pour donner à un corps en repos dix dégrés de vîtesse, qu'il en faut pour l'arrêter lorsqu'il est mu avec ces mêmes dix

dégrés de vîtesse. Or, on a vu comment dans le choc direct une petite force suffit pour faire perdre à un corps dix dégrés de vîtesse. Par conséquent, pour faire voir que le mo. per. est contradictoire, il faudroit faire voir qu'il implique contradiction, qu'avec un certain dégré de force, que je nomme *f*, on puisse communiquer à un corps une force dix fois plus grande que F, quoique cette même petite force *f* suffise pour faire perdre son mouvement à un corps dont la force seroit F. Or c'est ce qui me paroit pas avoir été entrepris jusques à présent.

Bien des Lecteurs seront étonnés de voir, entre les sentimens des Mathématiciens sur la force des corps, une différence aussi grande que celle dont nous avons parlé. La matière du choc des corps est une des moins éclaircies de la physique: plusieurs problèmes importants sur cette matière n'ont pas encore été examinés; & le manque de certaines expériences a empêché ceux, qui ont treté jusques à présent cette matière, quelque principe qu'ils ayent admis, de faire attention à tout ce qui devoit être consideré. J'aé publié un Introduction à la Philosophie de M. Newton. Tout ce que j'y dis du choc est fondé sur ce principe, que la force, qu'avec les autres Mathématiciens je nomme quantité du mouvement, est proportionelle à la masse multipliée par la vîtesse. En éncrivant ma Lettre à M. Newton, j'étois, comme je l'ai dis ci-dessus, encore dans le même sentiment. Les régles que les Mathématiciens ont données pour déterminer l'effet du choc de deux corps sont trop bien confirmées par l'expérience pour être révoquées en doute; il me paroissoit qu'elles étoient une suite du principe dont je viens de parler; & je soupçonnois d'autant moins que je pourois me tromper sur ceci, que ce qui regarde le choc des corps, du moins des corps non elastiques, a été déduit de ce même principe, par les Mathématiciens qui admettoient l'autre; ce qui me faicoit croire, que quoi qu'i'ls admissent ce dernier dans la spéculation, ils étoient obligés de l'abandonner, pour expliquer ce qui regarde les effets du choc.

Depuis, j'ai fait des expériences qui m'ont fait voir, d'une manière à ne laisser pas le moindre doute, que ce dernier principe, que la force des corps est proportionelle au quarre de la vîtesse multiplié par la masse, était véritable. Ce principe m'a menie à des conséquences qui m'ont paru bien paradoxes; mais, les ayant trouvées conformes à l'expérience, je me suis attaché à en rechercer les raisons, pour concilier ces expériences avec celles qui ont été faites touchant le choc. Le public jugera si j'ai réussi, par un Essai sur une nouvelle Théorie du choc, qui paroitra dans peu dans le 12, tome du Journal Littéraire, qui s'imprime à la Haye.* On verra aussi que, d'admettre l'un ou l'autre

* Cet Essai est celui qui a été inseré ci-dessus pag. 217, & a cette occasion il restà propos de remarquer, que ce que M. 's Gravesande

des principes dont nous avons parlé, ne change rien dans tout ce qu'on a demontré sur la projection des graves, sur les forces centrales, les centres d'oscillation, et plusieurs autres matières qui regardent le mouvement.

III. Quoique depuis ma Lettre écrite à M. Newton, j'aie entièrement changé de sentiment touchant la nature de la force dont dépend le choc, & que je ne croie plus qu'on puisse démontrer la possibilité de mo. per. par les raisons qu'on a veues ci-devant, & qui me paroissent encore des suites incontestables d'un principe géneralement reçu, je ne saurois me persuader néanmoins, qu'il soit possible de demortrer jamais, qu'il soit contradictoire de construire une machine qui auroit en soi un principe d'augmentation de force en conséquence des loix de la nature. Ces loix nous sont trop inconnues, et il y a peu d'apparence qu'on les découvre. Jamais toutes assez bien, pour en tirer une samblable conclusion. Il me paroit, au contraire, que ce que nous connoissons de ces loix nous doit faire envisager comme très possible une Machine tell qu'il nous faut pour gagner de force qui contre-balance ce qui se perd par le frottlement. La nouriture ne sert proprement qu'entretenir en état les materiaux qui composent la Machine.

Au reste, la question de la possibilité ou impossibilité du mo. per.; me paroit de fort peu de conséquence: mais il seroit à souhaiter que la forte persuasion dans laquelle sont les Mathématiciens, touchant cette impossibilité, ne les empêchât pas de faire une attention sérieuse à une machine aussi étonnante qu'est celle de Cassel. Une rou, dont le principe du mouvement est intérieur; qui se met en mouvement par le moindre effort; qu'on peut faire tourner du côté jugé à propos, sans que ce qui la fait tourner d'un côté soit arrêté par ce qui l'auroit fait tourner de l'autre, si elle y avoit été poussée; enfin, une roue, qui, après avoir fait ce que nous venons de décrire, quand même l'art humain ne pourroit jamais y parvenir.

Il y a dans la nature des principes actifs pour rétablir le mouvement qui se perd en tant de rencontres: on découvre de tels principes dans toutes les petites parties dont les corps sont composés; & on en voit des effets bien considérables dans les ressorts, dans les fermentations, et dans une infinité d'autres occasions. N'y auroit-il pas quelque témérité d'assurer qu'il soit contradictoire de mettre à profit ces principles? Il

vient de dire du sentiment sur la force qu'il a adopté dans son Introduction à la Philosophie de Newton, doit s'entendre de la première édition de cet ouvrage, qui a paru en 1720. Dans les deux autres éditions qui l'out suivie, & qui ont été publié en 1725, & 1742, il a établi que la force étoit proportionelle au quarré de la vîtesse d'un corps, multiplié par sa masse.

paroit probable, que c'est d'eux que dépendent les mouvemens dans les animaux, dont les corps me parroissent autant de mo. per. : le sang, qui circule, met en mouvement les muscles qui agitent le cœur : le cœur agité fait circuler le sang ; et dans chaque révolution, il quelques millions de tours, avec une rapidité suprenante, continue son mouvement de même, & n'est arrêtée qu'à force de bras ; une telle machine mérite, à ce qu'il me paroit, quelque éloge, quand même elle ne satisferoit pas à tout ce que l'inventeur en promet. Si c'est le mo. per., l'auteur mérite bien la récompense qu'il demande : si ce ne l'est point, le public peut découvrir une belle invention, sans que ceux qui auroient promis la récompense fussent engagés à rien ; l'inventeur n'ayant jamais exigé qu'une promesse conditionelle.* [Vol. 1, pp. 305-312.]

* Œuvres Philosophiques et Mathématiques de M. G. J. 's Gravesande, rassemblées & publiée par Jean Nic. Seb. Allamand. Amsterdam, 1774. 2 vols. 4to.

APPENDIX G.

Acta Ervditorvm anno 1715. Lipsiæ, 1715. 4to.

Nova Literaria Mathematica de Perpetuomobile, Longitudine Maris, & Quadratura a Circuli.

Licet irrito per tot secula conatu Mathematicorum ingenia defatigaverint perpetuum mobile, longitudo maris, & circuli quadratura, non tamen defuere anno proxime præterito, qui prolematum hactenus desperatorum solutionem giganteo ausu denuo aggressi sunt. Perpetuum mobile construxit *Orffreus*, Misnicus, vir in arte Medica, quam profitetur, & in Chymia atque Mechanica versatissimus: Longitudinem Maris inveniendi methodum excogitarunt *Dittonus* atque *Whistonus* Angli, eruditionis fama præstantes; Circuli Quadraturam publicavit *Daniel Waeyvvel* Batavus, Orbi erudito hactenus ignotus. Præstanda præstitit Germanus; ingenio suo non prorsus indigna dedere Angli; infelix in demonstrando suit Batavus.

Perpetuum mobile, quod *Orffreus* noster construxit, viderunt hominum myriades, & rerum Mathematicarum atque Mechanicarum peritissimi admirati sunt. Structura, quam inventor inventi præmium expectans studiose celat, simplicissima esse colligitur, quia non nisi unica rota cum axe suo cicumeunte constat. Diameter ejus quinque ulnas Lipsienses non excedit crassities 6 digitos non superat. Intervallo unius minuti horarii quinquaginta revolutiones absolvuntur & rota libere pendula nec ulla motore externo sensibili impulsa obstaculo remoto motum inchoat, eumque perenniter & æquabiliter admodum continuans pondus 60 immo 70 & amplius librarum ad aliquot orgyarum altitudinem attolere valet. Tam nobile inventum hactenus spectandum inventor in pago quodam Dreschwitz, non procul ab oppido *Ciza* sito; sed nunc locum mutare cogitur. [Pp. 46-7.]

APPENDIX H.

The following, by J. Bernoulli, is from the Appendix to "Opera Omnia," 1742:—

Vixdum Dissertationi huic colophonem imposui, cum mihi præcipitationis, & secretionis particularum naturam, ultimis pagellis breviter explicatam, sedulo contemplanti, ex hujus occasione, fortuito sese obtulit modus construendi, ope cujusdam liquoris continuo fluentis, decantatum illud & ab omni ævo desideratum Mobile Perpetuum pure artificiale; quem proinde hic, coronidis loco, ob materiæ affinitatem, Eruditis examinandum proponam. Neminem profecto latet, quam avide jam a longo tempore a Celeberrimis quoque Viris Motus iste Perpetuus sit quæsitus, quam ardenter efflagitatus: quid enim non excogitarunt? quot sumptus non impenderunt? quantasque non extruxerunt machinas? sed omnia in cassum,

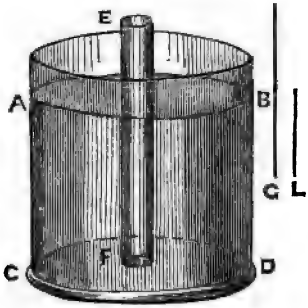
Πάντα γέλως, καὶ πάντα κόνις, καὶ πάντα τὸ μηδέν.

Vexat etiamnum & torquet continuo multos cœca Perpetui hujus Mobilis cupido, eorumque ingenia adeo incitat, ut auribus animisque Hominum Eruditorum absurda de hac re etiam proferri videamus: quæ tamen hodie plerique Viri docti rejiciunt; uanimiter asseverantes, Motum Perpetuum, nec dari, nec inveniri posse: quæ opinio eousque apud hos invaluit, ut satis temere pronuncient, ne audiendos quidem esse, qui tale quid se reperisse gloriarentur; quorum tamen rationes (ut fatear) ad me convincendum non sufficient; quin potius asserere non erubescam Motum Perpetuum, non solum inventu possibilem, sed prorsus inventum jam esse, ut quivis fatebitur, qui has legerit lineolas; & quid multis opus est? annon ipsa Natura (quæ nunquam non juxta leges mechanicas operari dicitur) possibile esse Mobile Perpetuum indicat? quid (ut hoc solum memorem) perennis fluminum & aquarum fluxus aliud est, quam Motus Perpetuus? anon omnia mechanice peraguntur? ergo, fateris, quod limites legum mechanicarum non excedit, illud impossible non est; quid proinde impedit, quo minus præeuntem Naturam hac in re, utut non tam perfecte imitari possimus? ut autem tandem finiam, possibilitasque Motus Perpetui artificialis salvetur, modum, quo conciliari possit, tibi ostendam, de quo ne in sinistram

partem temere judicium feras, vel pro Titanico conatu interpreteris, hunc ut prius acriter perpendas, vel, si lubet, rei veritatem ipse experiaris rogo.

Ante omnia præponenda sunt sequentia.

(*Tab.* 1, *Fig.* 8.)



I. Si sint duo liquores diversæ gravitatis, quorum gravitates sint in ratione G ad L; erunt, viceversa, altitudines cylindrorum æquiponderantium, & super æquali basi existentium, in ratione L ad G.

II. Ideoque si altitudo A C (Fig. 8) liquoris unius in vaculo A D contenti, sit ad altitudinem E F liquoris alterius in tubo utrinque aperto existensis, ut L ad G; liquores ita positi quiescent.

III. Proinde si A C ad E F sit in majori ratione quam L ad G; liquor in tubo ascendet; vel si tubus sufficienter longus non sit, liquor per orificium E prolabetur.

(Hæc ex Hydrostaticis probantur.)

IV. Possunt haberi duo diversæ gravitatis liquores, qui conjuncti invicem miscentur.

V. Potest haberi filtrum, colatorium, vel aliud secretorium, ope cujus liquor levior graviori immistus ab eodem iterum potest secerni.

Constructio.—His præsuppositis, Mobile Perpetuum sic construo. Sumantur in quacunque quantitate, si vis, in æquali, duo diversa gravitatis liquores invicem miscibiles (qui per hyp. 4. possunt haberi) illorumque ratio gravitatis prius exploretur, quæ sit ut G ad L gravioris ad leviorem, deinde illis permixtis impleatur vasculum A D usque ad A. Hoc facto sumatur tubus utrinque apertus E F, ejus longitudinis, ut sit $A\,C : E\,F > 2\,L : G + L$; hujus vero tubi orificium inferius F obstruatur, vel potius obducatur, filtro, vel alia materia quadam, secernente liquorem leviorem a graviori (quæ per hyp. 5.

etiam potest haberi); tandem tubus hoc modo paratus liquori immergatur usque ad fundum vasculi C D; dico, liquorem continuo per tubi orificium F ascensurum, & per orificium E in subjectum liquorem prolapsurum.

DEMONSTRATIO.—Quia tubi orificium F obductum est filtro (per constr.) quod liquorem leviorem a graviori secernit; sequitur, ut, si tubus immergatur ad fundum vasculi, liquor solummodo levior, qui graviori est immistus, per filtrum in tubum ascendere debeat, & quidem eousque ultra superficiem ambientis liquoris (per hyp. 2.) ascenderet, ut esset $A C : E F = 2 L : G + L$: quia vero (per constr.) $A C : E F > 2 L : G + L$, necesse est (per hyp. 3.) ut liquor levior, per orificium E, sese exoneret in vasculum subjectum, ibique denuo cum graviori conjugatur, & (per hyp. 4.) misceatur de novo; qui dein penetrando filtrum, in tubum rursus ascendat, interumque per superius orificium expellatur. Sic itaque fluxus continuabitur in perpetuum. Q.E.D.

COROLL.—Hinc commode reddi potest ratio, cur aqua, ex mari profundo ad summa usque cacumina montium jugiter ascendenda, ex iis saltuatim prorumpat & refluend sub forma fluminum, se refundat in Oceanum, sicque Natura nobis Perpetuum sistat Mobile. Hoc inquam, non bene explicant illi, qui dicunt eandem ob causam aquam ex mari in sublimius ferri per terra poros, ob quam liquor in tubilis perangustis ascendat ultra superficiem liquoris tubulos ambientis: nam, si ita res explicanda foret, nunquam demonstrare possent, cur eadem aqua, in altum elevata, e terræ gremio prolabatur; videmus enim, in angustis istis tubulis, licet tantillum supra liquorem ambientem emineant, nunquam tamen extra eorum ora sese evolvere, & in liquorem substratum decidere. Commodius itaque sit explicatur: notum est, aquam, in qua multum salis est dissolutum, graviorem esse eadem dulci; verum aqua marina, ut patet ex sapore, multas particulas salinas in se continent; proinde erit gravior quam aqua fontana vel fluvialis: credibile itaque est, quod cum terra vicem gerat filtri, per cujus poros aqua solum dulcis transire potest, relictis salinis particulis, quæ gravitatem aquæ augent; aqua dulcis per terram longe altius ascendere debeat, ob immensam Oceani profunditatem, ita ut ad altissima quoque montium fastigia, per pressionem aquæ marinæ, protrudatur; ex quibus dein, cum ultra ascendere nequeat, rivulorum instar emanet.*

* Johannis Bernoulli, M.D., Matheseos Professoris, &c. Opera Omnia, quæ ab Anno 1690 ad Annum 1713 prodierunt. Lausannæ et Genevæ 1742. 4 vols. 4to. [Vol. 1, pp. 41-4.]

ADDENDA.

Belgian Patents.

Meeting accidentally with a work entitled "Recueil Spécial des Brevets d'Invention," published at Brussels for the promotion of art, in 3 vols., royal octavo, 1855 to 1857, the following is a list therefrom:—

1. G. Wynen, 1854. For a perpetual motion. A vertical wheel turning on a horizontal axle. It has radial holes containing metal balls, moving freely. (Vol. 1, p. 248.)

2. J. R. Delguey-Malava, 1854. For a movement by continual gravitation. The machine seems to be composed of an axle carrying weighted levers. (Vol. 1, p. 634.)*

3. D. Preumpler, 1855. For a system of perpetual motion. It is a combination of tubes, in which water is kept in constant movement. (Vol. 2, p. 50.)

4. H. J. Botermann, 1856. For a perpetual motion by a vertical wheel. It has balls moving in guides. (Vol. 2, p. 414.)

5. L. Melard, 1856. For perpetual motion. It is a horizontal axle, crossed perpendicularly with straight moveable iron bars, which meet in eccentric curves during rotation. (Vol. 2, p. 556.)

* See Chapter XI., p. 446.

6. F. Grenier, 1857. For a system of perpetual motion. It is a large wheel, furnished with spokes and weights, and operates by maintaining the weight to one side. (Vol. 3, pp. 655 and 942.)

7. J. E. Humbert, 1857. For a double apparatus of perpetual motion. It consists of wheels and levers, which it is represented work on a very simple principle. (Vol. 3, p. 707.)

8. A. M. Timbrell, 1857. For a system of constant motive power. A combination of pulleys to produce a "mechanical stimulant" to equalize reaction and create power. (Vol. 3, p. 959.)

9. F. le Compte, 1857. For an articulated fly-wheel or perpetual motion. A combination of levers to create a force sufficient to reproduce itself and cause a circular movement. (Vol. 3, p. 976.)

Polytechnic Institution, Regent Street.—Two fictitious perpetual motions, applied as Time-pieces, may here be seen. They are described as patented by M. Moinau de Montauban.

In their glass shades they stand 2 feet high, on a base of 18 inches. The clocks have flat annular dials, each supported on 2 pillars; each has behind the dial a wheel with 4 spokes, having around the periphery 12 arms terminating in cupped rings to receive and deliver balls of about three quarters of an inch in diameter. One clock delivers these balls to the top side of the wheel by an Archimedean spiral; the other elevates them by a lever. These models must have cost between one and two hundred pounds; and it is quite obvious that they must have received external aid through apertures which may be seen in the back of the base of each. Other portions of reputed Perpetual Motion machinery were exhibited by the same patentee, called the "Volant Moteur Perpétuel," but are removed.

On certain conditions under which a Perpetual Motion is possible. By GEORGE BIDDELL AIRY, M.A., Member of the Astronomical Society, Fellow of Trinity College, and of the Cambridge Phil. Society, &c., &c. (Read Dec. 14, 1829.)

It is well known that Perpetual Motion is not possible with any laws of force with which we are acquainted. The impossibility depends on the integrability *per se* of the expression $X\,dx + Y\,dy + Z\,dz$: and as in all the forces of which we have an accurate knowledge this expression is a complete differential, it follows that perpetual motion is incompatible with those forces.

But it is here supposed that, the law of the force being given, the magnitude of the force acting at any instant depends on the position, at that instant, of the body on which it acts. If, however, the magnitude of the force should depend not on the position of the body at the instant of the force's action, but on its position at some time preceding that action, the theorem that we have stated would no longer be true. It might happen that, every time that the body returned to the same position, its velocity would be less than at the preceding time: in this case the body's motion would ultimately be destroyed. On the contrary, it might happen that the body's velocity in any position, would be more rapid every time than at the time previous. In this case the velocity would go on perpetually increasing: or, the velocity might be made uniform if the machine were retarded by some constantly acting resistance: or, in other words, the machine might move with uniform velocity, and might at the same time *do work:* which is commonly understood to be the meaning of the term *perpetual motion:* If the machine had no work to do, the increasing friction, &c., would operate as an increasing work, and the velocity would be accelerated till the acceleration caused by the forces was equal to the retardation caused by the friction; after which it would remain unaltered.

For this idea I am indebted to the admirable account of

the organs of voice given by Mr. Willis. The phenomenon to be explained was this. When two plates are inclined at an angle greater than a certain angle, it is found that the effect of a current of air passing between them is to give a tendency to open wider. When they are inclined at any angle smaller than that certain angle, the effect of the current is to make them collapse. If, then, the plates be supposed to vibrate through the position corresponding to that angle, the tendency of the forces at all times is to bring them to that position. Each plate is in the state of a vibrating pendulum: and whatever be the law of force which acts on it, it is certain that if the force be the same when the plate is in the same position, this force will have no tendency to increase the velocity. The retardation arising from friction, &c., will, therefore, soon destroy the motion. But it is found, in fact, that the motion is not destroyed. What then is the accelerating force which keeps up the motion? Mr. Willis explains this by supposing that *time* is necessary for the air to assume the state and exert the force corresponding to any position of the plate: which is nearly the same as saying that the force depends on the position of the plate at some previous time. In this paper, which is intended to investigate the mathematical consequences of an assumed law, I shall not discuss the identity of these suppositions: I shall only remark that the general explanation appears to be correct, and that it clears up several points which always appeared to be in great obscurity.

Let us now consider the case of a vibrating body acted on by two forces, of which one is proportional to its actual distance from the point of rest, and the other proportional to its distance at some previous time. Putting $\phi(t)$ for the body's distance, the equation is

$$\frac{d^2 . \phi(t)}{d t^2} = - e . \phi(t) - g . \phi(t-c).$$

This equation I am unable to solve rigorously: but on the supposition that g is small, an approximate solution may be

obtained from the formulæ in the Memoir on the Disturbances of Pendulums, &c. (*Cam. Trans.* Vol. III., p. 109.) Neglecting at first the small term, we have

$$\frac{d^2\phi(t)}{dt^2} = -e.\,\phi(t),$$

whence

$$\phi(t) = a.\ sin\ (t\sqrt{e} + b).$$

Consequently,

$$\phi(t-c) = a.\ sin\ (t\sqrt{e} + b - c\sqrt{e}),$$

and therefore f in the formulæ alluded to is

$$= ag\ sin\ (t\sqrt{e} + b - c\sqrt{e}).$$

The increase, therefore, of the arc of semi-vibration is

$$-\frac{1}{\sqrt{e}}\int_t ag.\ sin\ (t\sqrt{e} + b - c\sqrt{e})\ cos\ (t\sqrt{e} + b)$$

$$= -\frac{ag}{2\sqrt{e}}\int_t \left\{ sin\ (2t\sqrt{e} + 2b - c\sqrt{e}) - sin\, c\sqrt{e} \right\}.$$

To find the increase from one vibration to another, we must take the integral between two values of t differing by $\frac{2\varpi}{\sqrt{e}}$: and thus we obtain for the increase $\frac{\varpi\, ag\ sin\ c\sqrt{e}}{e}$.

I shall not occupy the time of the Society by a discussion of the different values of the increase corresponding to different values of c: I shall only remark that if $c\sqrt{e}$ be less than ϖ the arc of vibration increases continually. Nor shall I consider the cases in which c is supposed to be a function of the position or velocity of the vibrating body (which possibly might better represent the circumstances that originally suggested this investigation). My object is gained if I have called the attention of the Society to a law hitherto (I believe) unnoticed, but not unfruitful in practical applications.—Observatory, Dec. 13, 1829.—[Transactions of the Cambridge Philosophical Society. Vol. 3, 1830. 4to. Pp. 369—372.]

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'P

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